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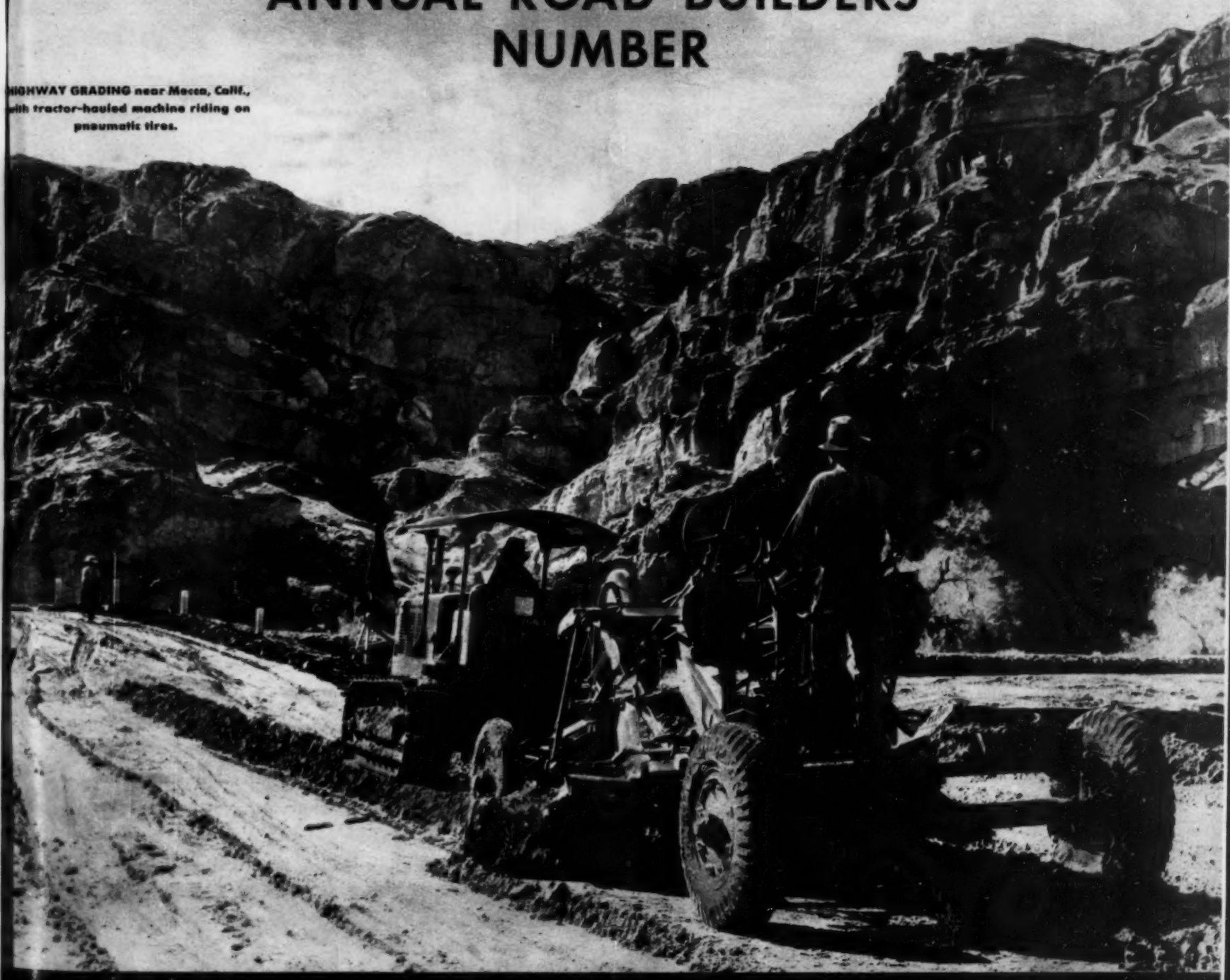
# Construction Methods and Equipment

McGraw-Hill Publishing Company, Inc.

January, 1937

Price 20 Cents

## ANNUAL ROAD BUILDERS' NUMBER



HIGHWAY GRADING near Mecca, Calif., with tractor-hauled machine riding on pneumatic tires.

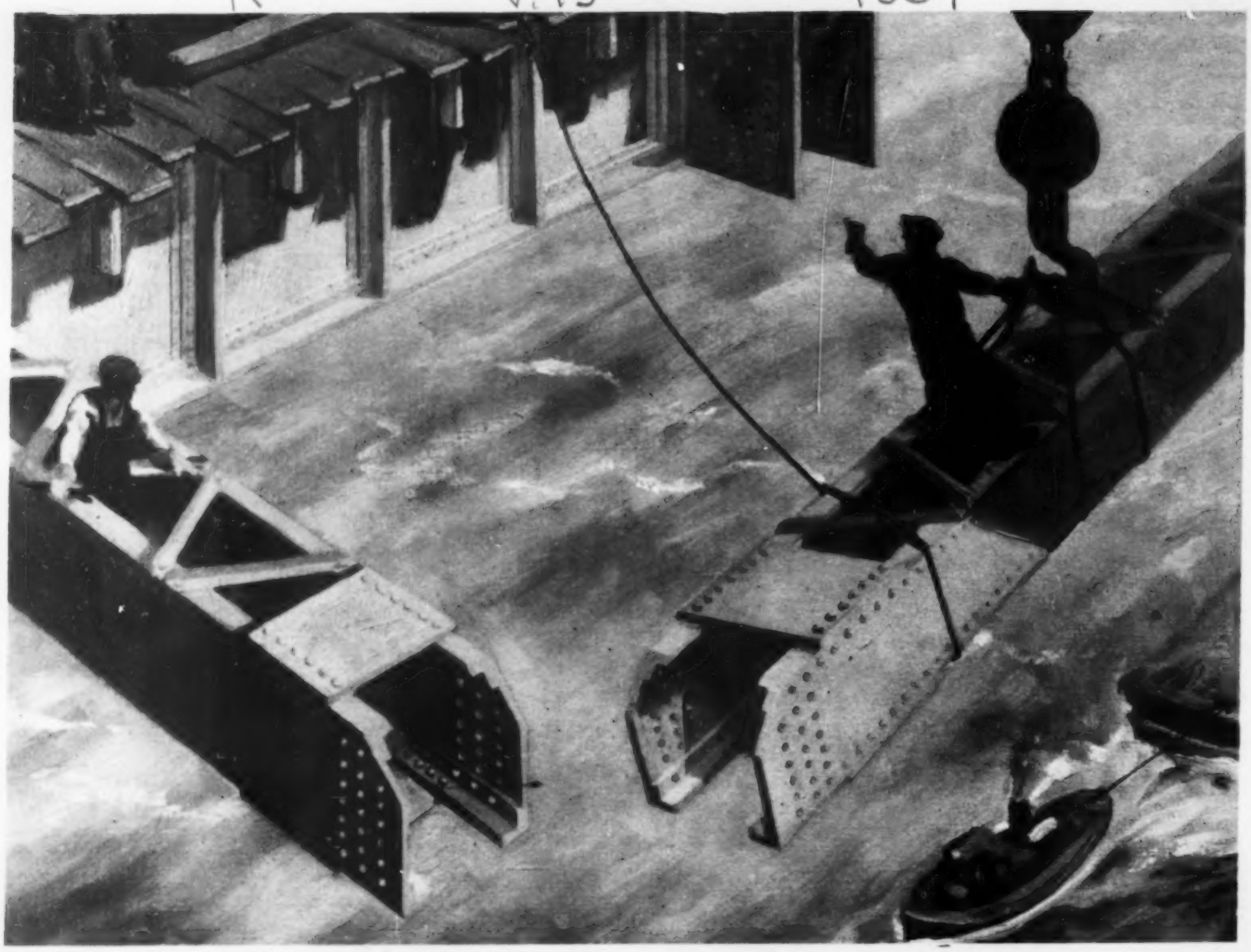
Mountain Grading by 16 Contractors
Tar Retread Surface
Paving with New and Salvaged Brick
Man-Hour Costs

Four Safety Features:
1. "Built-In" Safety
2. Bituminous Sidewalks
3. Sodium Lighting
4. Marking Roads

Sub-Oiling to Produce Stable Base
Vibrated Concrete
Wide Approach to Bridge
Pavers in Parallel

NEW ENLARGED "CONSTRUCTION EQUIPMENT NEWS" SECTION

R v.19 1937



# Miracle Building with Inland Structural Steel

**THE MILL and THE MEN . . . *that's* INLAND**

It is perhaps quite impossible to impart an intimate idea of how Inland mills and men seem to blend into one great instrument of service to American Industry. • A personally conducted trip through one of the Inland Plants would help toward such an understanding. • You are cordially invited to visit whenever it may be convenient for you.

*Principal Products*

SHEETS STRIP TIN PLATE
PLATES STRUCTURALS PILING
RAILS TRACK ACCESSORIES
BARS BILLETS

Many present day structures are literally miracles of building . . . and each year brings new wonders, new revelations of the ability and genius of architects, engineers and contractors. Tunneling deeper into the earth, building higher into the sky, and spanning vast stretches of water—these men use only materials on which they can depend without question. We are, therefore, particularly pleased that Inland Products are so extensively specified. Thousands of tons of Inland structural steel go into bridges, buildings, dams, seawalls and other structures every year. • But furnishing uniformly strong, dependable steel is only a part of the picture, for Inland Engineers work closely with designers, fabricators and erectors, from foundation to flag pole, making practical suggestions, deliveries as needed, and giving that close personal attention to every detail that saves time and means so much to successful building.

**INLAND STEEL CO.**

General Offices: 38 South Dearborn Street, Chicago, Illinois

TECHNOLOGY DEPT.

# CURRENT JOBS

## ...and Who's Doing Them

### Buildings

**Public** — The Housing Division of PWA let four superstructure contracts as follows: Laurel Homes in Cincinnati to **David Gordon Construction Co.**, of Cincinnati, Ohio, $6,500,000; Brand Whitlock Homes in Toledo, Ohio, to the **Ring Construction Co.**, of Minneapolis, for $1,284,000; Logan Fontenelle Homes in Omaha, Neb., to **Peter Kiewit's Sons Co.**, of Omaha, for $1,283,000. Adams Housing project, in Chicago, to **M. L. Bein, Inc.**, and **Malkov Lumber Co.**, both of Chicago, for $2,224,334.

In Chicago, a $3,147,000 contract for a museum building and lagoon in Jackson Park, went to **R. C. Wieboldt Co.**, of Chicago. In Boston, Mass., **Thomas A. Pearson,** of Springfield, Mass., is building an 11-story office building for $1,500,000. A bid of $515,000 obtained a 5-story court house and jail contract in Oshkosh, Wis., for **Lundoff-Bicknell Co.**, of Chicago. **Maurice Schumacher** bid in for a $419,700 general contract for a high school in Menasha, Wis. For constructing a white marble state house in Salem, Ore., **R. B. Hammond,** of Portland, Ore., obtained a $2,006,137 contract.

**Industrial** — The Republic Steel Co. has selected the **Hunkin-Conkey Construction Co.**, of Cleveland, Ohio, to build a $15,000,000 strip mill along Cuyahoga River, Cleveland. A $4,350,000 power plant is being built by **Stone & Webster Engineering Corp.**, New York City, for the Brooklyn Manhattan Transit Co., in Brooklyn, N. Y. At Brunswick, Ga., the Brunswick Pulp & Paper Co., has engaged **Stone & Webster Engineering Corp.**, to build a $3,500,000 plant. Contract for the design and construction of a blast furnace for the Inland Steel Co., at Indiana Harbor, Ind., has been awarded to **A. G. McKee & Co.**, of Cleveland, Ohio, for $2,500,000. Plant improvements for the Moline-Rock Island Mfg. Co., at Bettendorf, Ia., will be undertaken by the **United Light & Power Co.**, of Davenport, Ia., under a $1,500,000 contract. **C. W. Angle, Inc.**, of Greensboro, N. C., is erecting in that city a $750,000 rayon plant for Wilbert J. Carter. At Rodessa, La., a gasoline plant and refinery, to cost $300,000, is under construction for the Cass-Liberty Gasoline Co., by the **Petroleum Engineering Co., Inc.**, of Tulsa, Okla.

**Commercial** — For the Southern New England Telephone Co., at New Haven, Conn., the **Dwight Building Co.**, of New Haven, is constructing a $2,000,000 brick and steel executive office building. A bid of $900,000 obtained for **F. Messer & Sons,** of Cincinnati, Ohio, contract for a 7-story reinforced concrete store building from J. Shillito Co. Under separate contracts, **M. Goetz,** of Brooklyn, N. Y., is building at Jackson Heights, N. Y., a $600,000 apartment. A group of 150 brick dwellings for the **Economy Housing & Development Corp.**, at Springfield, N. Y., is under way with day labor at a cost to exceed $500,000. At Potsdam, N. Y., a hospital administration building costing $350,000, has been started by **Hegeman-Harris Corp.**, of New York City.

### Sewers

Low bidder on sewage pumping station and sedimentation tanks at Buffalo, N. Y., was **Bryant & Detwiler Co.**, of Detroit, with a price of $1,713,572. A sewer tunnel contract in Detroit, Mich., including underpinning of railroad viaduct, was bid in for $1,339,000, by **G. R. Cooke,** of Detroit. A $1,207,800 contract for concrete diversion sewer in Chicago, was awarded by the Chicago Sanitary District to **Paschen Bros. Construction Co.**, of Chicago. **J. Rich Steers,** of New York, bid $334,780, for a sewer outfall and bulkhead pier at Tallman Island sewage treatment works, New York City. In Pittsfield, Mass., **F. H. McGraw & Co.**, of New York, is building a sewage treatment plant for $159,000.

### Waterworks

For $729,000, **United Engineers & Constructors, Inc.**, of Philadelphia, is building a water filtration plant at Hine, Mo. Contract for conduit on Moffat Tunnel extension project in Denver, Colo., was awarded to **Williams Bros.**, of Tulsa, Okla., for $605,297; on the same project in Denver, Colo., a $493,857 contract was awarded to the Lock Joint Pipe Co., of Denver.

### Subways

Low bidder on another section of the Sixth Ave. subway in New York City, between 18th and 27th Sts., was **Arthur A. Johnson Corp.** and **Necaro Co., Inc.**, of Long Island City, with a price of $4,722,000. Contract for the section of the Sixth Ave. subway, New York, from 47th to 53rd Sts., was awarded to **G. H. Flinn, Inc.**, of New York, for $4,616,476.

### Highways

State highway departments have awarded the following contracts: North Carolina, $656,697 to **M. E. Gillioz,** of Monett, Mo., for 8 mi. of road in Buncombe County. Indiana, $345,631 to **R. McCalman, Inc.**, of Danville, Ill., for reinforced concrete paving in Putnam County. New York, $312,073 to **P. Knickenberg,** of Buffalo, N. Y., for 7 mi. in Chautauqua County; $252,648 to **Warren Bros. Road Co.**, Cambridge, Mass., for 6.6 mi. in Wayne County; $243,422 to **Utica Construction Co., Inc.**, Utica, N. Y., for 2.4 mi. in Erie County; $400,571 to **Parlor City Construction Co.**, of Vestal, for 5.7 mi. in Oneida County. Arkansas, $267,365 to **A. C. Campbell Construction Co.**, of Shreveport, La. Mississippi, $312,559 to **Cage Bros.**, of Bishop, Tex., for 15 mi. in Itawamba County. California, $225,381 to **Fredericksen & Westbrook,** of Lower Lake, Calif., for concrete paving near Donner Summit. Iowa, $364,741 to **Booth & Olson, Inc.**, Sioux City, for 12.8 mi. in O'Brien County; also, $370,649 to **J. S. McLaughlin & Sons,** of Des Moines, for 14 mi. in Lyon County. Illinois, $203,859 to **Harrison Engineering & Construction Co.**, of Kansas City, Mo., for 7.6 mi. in Carroll County. Pennsylvania, $247,783 to **H. W. Shaull & Sons,** of Mechanicsburg, for 5 mi. in Mifflin County.

### Bridges

In Chicago, at $655,308, bridge contract went to **Ketler Elliott Co.**, of Chicago. In Florida, the **Wisconsin Bridge & Iron Co.**, of Milwaukee, obtained two bridge contracts for $486,454 and $338,600 respectively. State highway bridges in New Jersey, were awarded to **F. McDowell,** of Neptune, N. J., for $476,692.

### Dams

U. S. Bureau of Reclamation awarded contract for Marshall Ford dam on lower Colorado River in Texas, to **Brown & Root,** of Austin, Tex., and **McKenzie Construction Co.**, of San Antonio, for $5,781,235. Vertical lift gates and hoisting machinery at Emsworth Dam, Emsworth, Pa., are being installed by American Bridge Co., of Pittsburgh, for $815,800. On the Rio Grande near El Paso, Tex. a diversion dam and canal contract has been given to **Austin Bridge Co.**, and **Austin Road Co.**, of Dallas.


# Construction Methods and Equipment

*Copyright, 1936* McGraw-Hill Publishing Co. Inc., 330 West 42nd St., New York

ROBERT K. TOMLIN, Editor — **JANUARY, 1937** — WILLARD CHEVALIER, Vice-President

*Editorial Staff*: Vincent B. Smith, John B. Huttl (San Francisco), Paul Wooton (Washington), Nelle Fitzgerald

CONSTRUCTION Methods and Equipment was founded in 1919, under the name of SUCCESSFUL METHODS, by the Manufacturers Publicity Bureau, Inc., of Chicago, representing a group of non-competing manufacturers of construction equipment. Charles R. Thomas, editor of the first few issues, was succeeded by William Jabine.

In 1926 the McGraw-Hill Publishing Company, Inc., of New York, purchased the publication, changing its name to SUCCESSFUL CONSTRUCTION METHODS in November of that year, to CONSTRUCTION METHODS in May, 1927, and to CONSTRUCTION Methods and Equipment in December, 1936, in order more accurately to define its field and purpose.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Robert K. Tomlin was appointed editor of CONSTRUCTION METHODS in January, 1928. Vincent B. Smith is associate editor; John B. Huttl, (San Francisco) Pacific Coast editor; Paul Wooton, Washington representative; and Nelle Fitzgerald, assistant editor.


## The "How" of it:

*For the benefit of readers concerned with the practical application of method or equipment the following references are to articles or illustrations in this issue that tell:*


**How THREE FINISHING MACHINES followed twin mixers on concrete paving job.** — p. 41

**How PNEUMATIC-TIRED 12-YD. SCRAPER moved almost 60,000 cu.yd. of earth and shale in one month.** — p. 46

**How WHEEL SCRAPER of 7-yd. capacity handled boulders in random excavation.** — p. 46

**How REPEATED SPRINGING and double-deck loading of drill holes saved explosives in shooting vertical rock faces.** — p. 47

**How NON-GLARE ILLUMINATION for night driving was provided by installation of sodium vapor lamps.** — p. 49

**How EXTENSIBLE LADDER, mounted on motor truck, aided setting of highway lighting units.** — p. 49

**How DIRECTIONAL AND WARNING SIGNS improved convenience and safety of Massachusetts highways.** — p. 50

**How NEW AND SALVAGED BRICK were used to pave highway.** — p. 54

**How ASPHALT MASTIC CUSHION for brick pavement was prepared in batch-type plant.** — p. 54

**How HOLLOW TEETH of sub-oiling machine injected liquid bituminous material in soil road.** — p. 56

**How SUB-OILING METHOD of introducing liquid bituminous material in moist soil road resulted in upward diffusion through mass.** — p. 56

**How COSTS of labor and materials compared with total costs of highway contracts.** — p. 62

**How BITUMINOUS SIDEWALKS were built as safety measure along state highways.** — p. 64

**How GRANITE CURBING, with vertical and inclined faces, was set along sidewalks.** — p. 65

**How VIBRATORY FINISHING MACHINE maintained steady progress on concrete paving job in rural location.** — p. 70

**How VIBRATION OF CONCRETE PAVEMENT eliminated spading at joints and alongside edge forms.** — p. 71

**How ROAD-MIX MACHINE, powered by diesel engine, built bituminous shoulders.** — p. 73

**How SCATTERING of stone chips on asphaltic surface was done from wood sled towed by truck.** — p. 75

**How PAVEMENT BUMPS were detected by inspector with 6-ft. rolling straight-edge.** — p. 75

**How SPRING-TOOTHED HARROW prepared road-mix surfacing.** — p. 76

**How MECHANICAL SPREADER distributed truck-mixed concrete laterally between pavement forms.** — p. 76

**How SNOW DIPPER of 3-cu.yd. capacity, rigged on ¾-cu.yd. power shovel, cleared highways in winter.** — p. 76

**How FIRM ROAD SHOULDERS were obtained with cotton fabric strips treated with asphalt and sand.** — p. 76

**How SIDE CASTING of earth from shallow borrow pits was done, with long reach, by pair of elevating graders.** — p. 77

**How SUBGRADE BRIDGE enabled batch trucks on paving jobs to cross over subgrading machine.** — p. 77

**How ORNAMENTAL BRIDGE HAND RAIL, of copper-bearing steel, was designed to permit scenic view of river.** — p. 77

**How DITCH CLEANING along highway was handled by bucket elevator and belt conveyor rig.** — p. 77



# CURRENT JOBS

## ...and Who's Doing Them

# THE HIGHWAY *Comes of Age*

THE ANNUAL convention of the American Road Builders' Association again focusses attention on the problems and prospects of the highway industry.

Today the observer of highway conditions senses a substantial change in the outlook. That change is for the better. Not so long ago many of our people were half convinced that the road building job was about completed. From now on, they thought, it will be a matter of maintenance only.

This error was zealously fostered by groups interested in the public functions that do not produce revenue. To them the highway revenues appealed as a juicy and tempting morsel. The fact that those revenues were earmarked, always morally and often legally, for highway improvement exclusively meant nothing to the raiders or to some public officials who lacked the stamina to demand straightforward taxation to meet their legitimate needs.

These active attacks on highway improvement were helped by the passive attitude of the vast army of citizens most directly and vitally concerned. And with this combination of aggressive attack and feeble defense, it looked, just a few short years ago, as though American highway development was due for a staggering setback.

From this it was saved by the successful efforts to have road work take its very effective place in the federal emergency works program. And although this gave rise to some unfortunate excursions into day-labor and primitive methods, it is well to remember that these are but temporary evils and that the emergency program probably saved the industry from more or less complete collapse.

TODAY THE outlook is much brighter. With the growth of public revenues through business recovery, the raids on highway revenues will tend to diminish. Daily driving over inadequate roads is bringing home to every motorist the fallacy of the "over-built highways" propaganda. The mounting toll of accidents drives home the hazards of the obsolete highway. The economic and social values created by motor transport are understood by more of the people who now see the efforts to obstruct its progress for what they really are. Farmers living on thousands of miles of unimproved roads want to know when they will be connected up with the trunk net-work. Taxpayers are becoming more critical of the cost and waste of day-labor relief work.

But most heartening of all is the new spirit of militant unity that inspires those who have a stake in motor transport. The motorist is on the warpath and is making himself felt at the polls. The millions who earn their bread producing, selling and servicing motor cars, accessories, tires and gasoline, the operators of buses, trucks, garages and filling stations and many others are coming to understand that the modern, thoroughly adequate highway is essential number one in their very existence. They know that the surest way to obstruct automotive progress is to throttle highway development.

ALL THESE are coming to see that the highways are *their* highways, in which they have a huge investment. They are learning that they can protect this investment only as they maintain their highways in first-class shape and as they extend and improve them to meet expanding needs. They are learning that the cost of owning and driving their cars also depends on how well they do that job. They have come to see that the first requirement of highway safety is a safe highway.

So they are cracking down on the misuse of the taxes they pay to improve their highways. Some have amended their state constitutions to end that abuse; others are moving to that end. The highway users and the motor transport industry in all its branches today are awake and becoming conscious of their strength.

So, in this new spirit and with these new allies, the highway industries must carry on with redoubled energy. Now that they are pulling with the tide their efforts will be more productive. But on no account should they relax those efforts.

The New Orleans convention may well mark the point at which American highway improvement passes definitely from the formative stage into its maturity as a recognized element of modern motor transport. As such it becomes an enterprise of vital concern to the millions engaged in that far-flung activity.

Willard Chevalier

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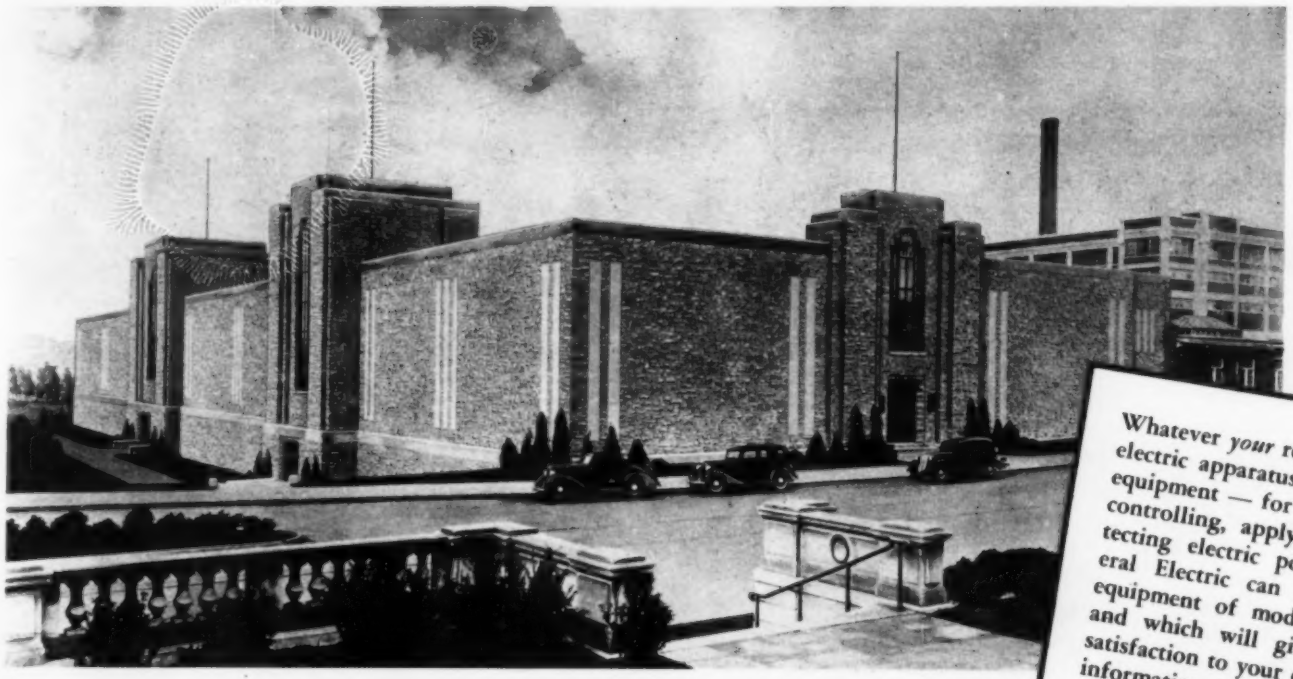
# INSIDE, THE WEATHER'S FINE —ALL YEAR ROUND

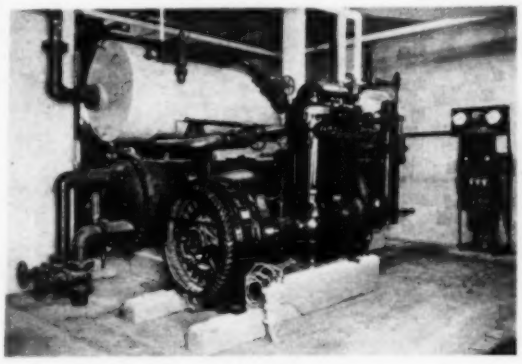


Whatever *your* requirements in electric apparatus for building equipment — for distributing, controlling, applying, or protecting electric power — General Electric can furnish the equipment of modern design, and which will give greatest satisfaction to your clients. For information on electric apparatus, get in touch with the G-E office near you. General Electric, Schenectady, N. Y.

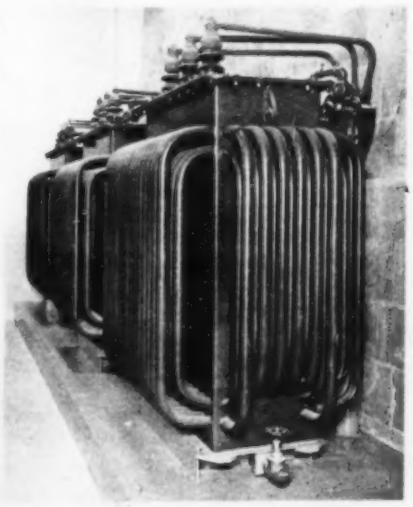
INSIDE the Hershey Building, at Hershey, Pa., a complete system of refrigerating machines assures a year-round supply of conditioned air, continually washed and filtered. The system provides "heat relief" in summer through maintenance of a temperature ratio of 3 to 1. When the outside temperature goes up three degrees, the inside goes up one. In the winter, an even, healthful heat keeps the offices comfortable. At all seasons the relative humidity is determined by machinery and not by the change of outside weather.

To complete the air conditioning of this four-story, 150-by-350-ft. building required an extensive system with a rating of 425 tons of refrigerating capacity per day. This was designed and installed by York Ice Machinery Corporation. The windowless design of the building makes possible a saving of 25 per cent in air-conditioning operating cost because of the prevention of heat leakage through windows.

Another factor in low operating cost is the use of General Electric motors and control for the thirty-five different drives required for the conditioning machinery. General Electric distribution and protective equipment, too — transformers and circuit breakers — were chosen for the important functions of keeping electric current supplied at proper voltage for all light and power requirements in the new building.



G-E synchronous motor driving York refrigerating compressor

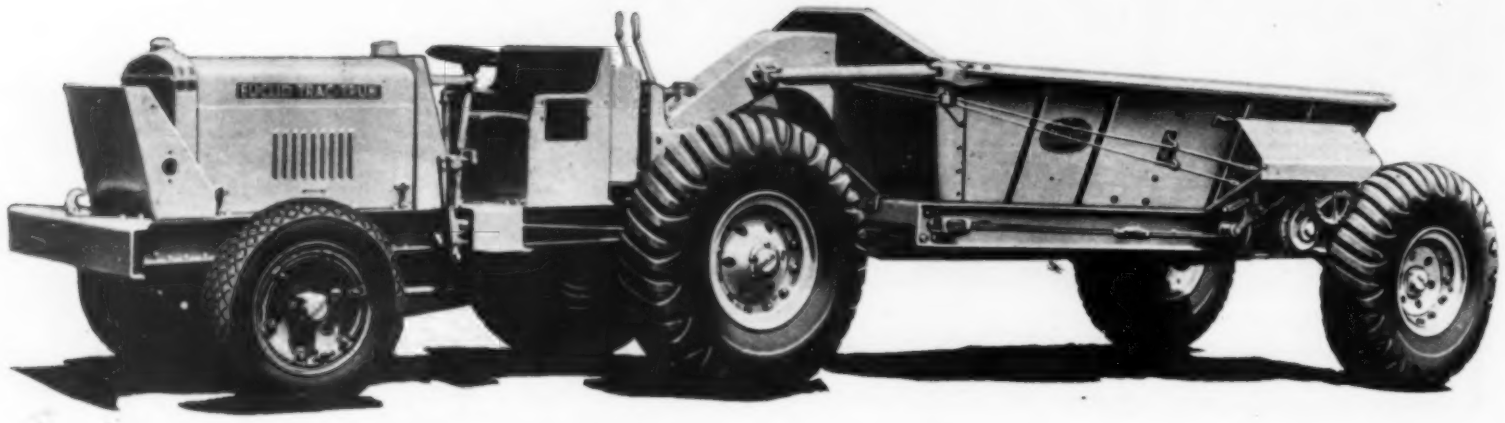


Three of six G-E 300-kva transformers which step down incoming power to operating voltage for the building

011-159

# GENERAL ELECTRIC

# "CARRIES BIG LOADS ...MOVES THEM FASTER ...WITH MORE HAULING ECONOMY"★



★ *This operator's statement quoted, points the way to Contractors and Road Builders in looking ahead to* **1937**

**BOTTOM DUMP**

# TRAC-TRUK

OVER 500 IN OPERATION ON THE NATION'S BIGGEST JOBS MOVING MATERIAL MORE EFFICIENTLY

OFFERS GREATER CAPACITY • • • POWER • • • SPEED • • • LESS DEAD WEIGHT • • • BETTER FLOTATION • • • POSITIVE TRACTION

NEW 12-15 TON

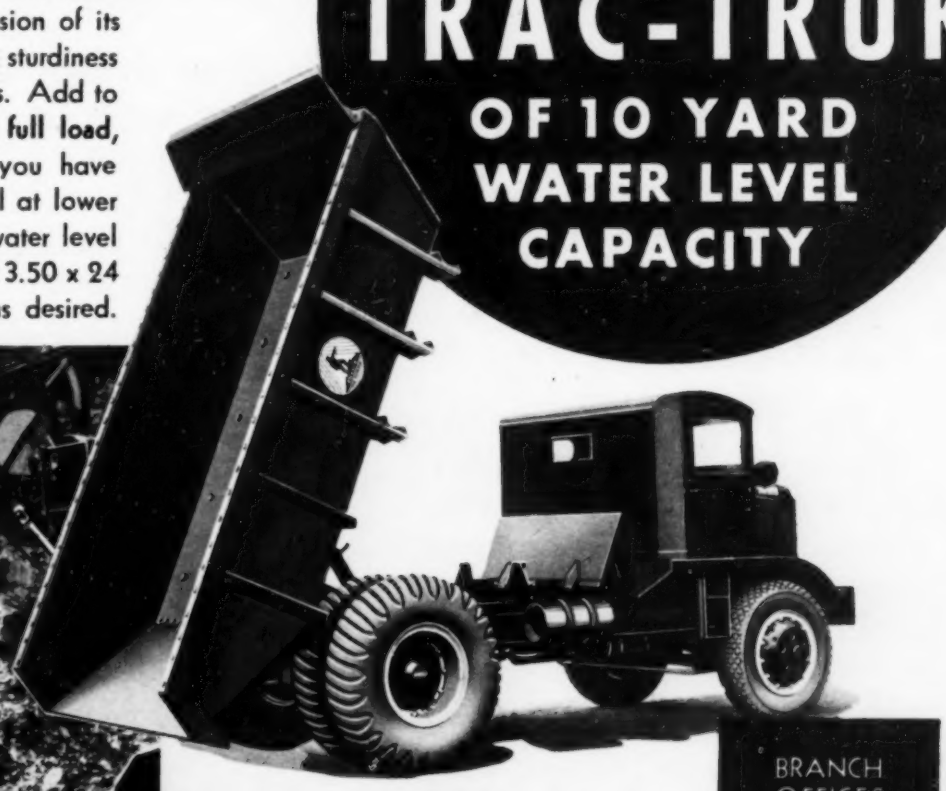
*Rear Dump*

# TRAC-TRUK

OF 10 YARD WATER LEVEL CAPACITY

## A FINE HEAVY DUTY HAULING UNIT OF PROVED QUALITY AND PERFORMANCE

OBSERVERS of this Trac-Truk in operation have been quick to express their favorable impression of its trim design—quality construction—enduring sturdiness—and abundance of power for all emergencies. Add to these the **notably faster hauling speed under full load,** together with quicker dumping action and you have everything that it takes to move more material at lower unit cost. Equipment includes a ten cu. yd. water level capacity body—four wheel brakes—dual 13.50 x 24 tires in the rear and Diesel or gas power as desired.



This well built body is of the sandwich type and hoists speedily to a high dumping angle which results in most rapid and satisfactory unloading action.

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210 Fourth Street
ROANOKE, VA.

**THE EUCLID ROAD MACHINERY CO. · Cleveland, Ohio, U. S. A.**

*1800 feet of 2¾ inch "HERCULES" (Red-Strand) Wire Rope being prepared for shipment to the Pickwick Landing dam now being built by T.V.A. on the Tennessee River near Corinth, Miss.*

# "R-U-S-H" *Were the Instructions—And We Shipped Three Days Ahead of Schedule*

On the afternoon of November 11, 1936, the Purchasing Department of T.V.A. at Knoxville long-distanced us to enter an emergency order for 1800 ft. of 2¾ inch "HERCULES" (Red-Strand) Wire Rope for track line on one of their cableways at the Pickwick Landing Dam.

The shipping date set for this order was November 21, or 8 working days, with instructions to ship sooner if possible. Shipment was made November 18—three days ahead of schedule.

Our ability to handle a special order of this kind so promptly is not a matter of chance. It is due to our facilities which consist of a modern plant, modern equipment, and an experienced and efficient organization.

And these same factors enable us to produce Wire Rope of the very highest quality, for quality as well as service must be brought about by definite causes. Why not send us your next order for wire rope, thereby securing the benefits of our proven facilities?

*Made Only By* **A. Leschen & Sons Rope Co.** *Established 1857*

**5909 Kennerly Avenue, St. Louis, Mo.**

| | | | |
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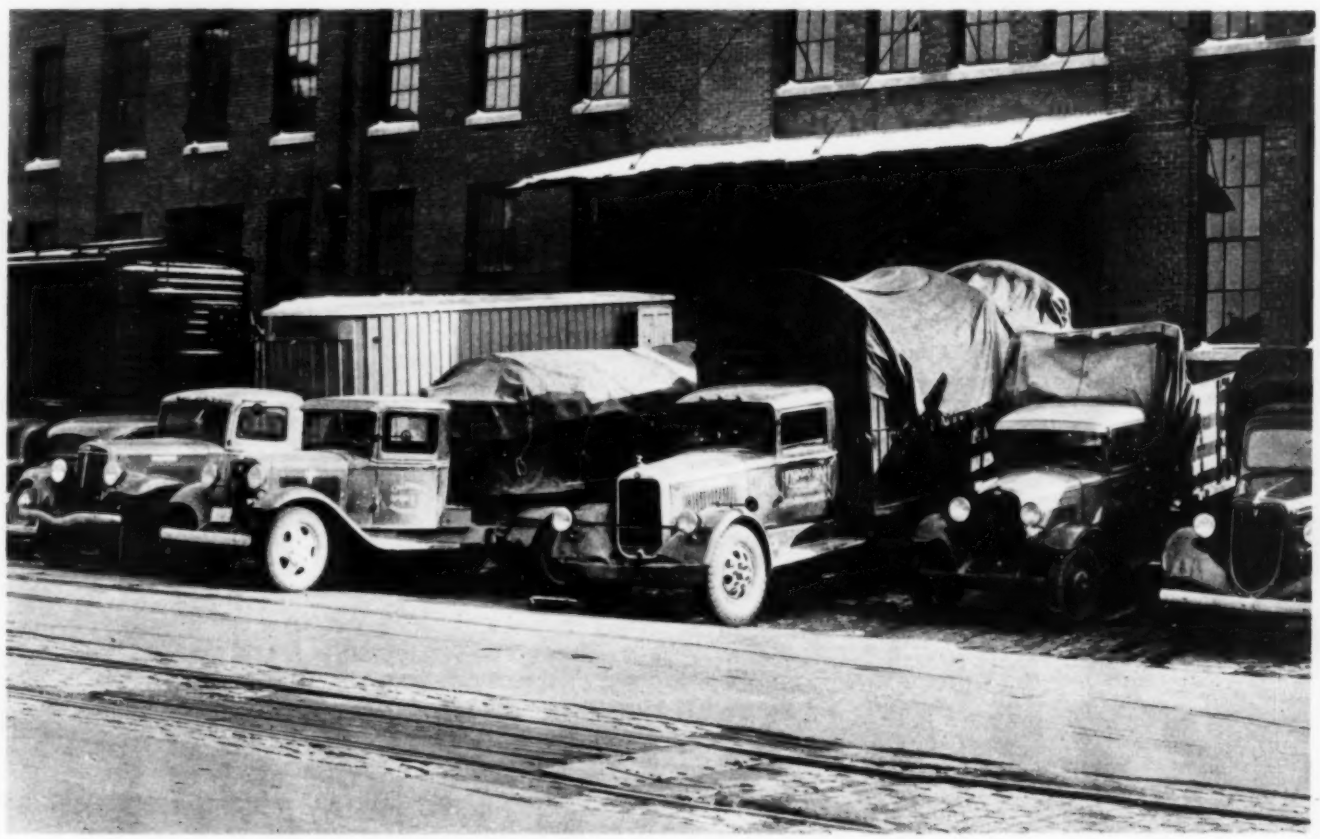
| New York | 90 West Street | San Francisco | 520 Fourth Street |
| Chicago | 810 W. Washington Blvd. | Portland | 914 N. W. 14th Street |
| Denver | 1554 Wazee Street | Seattle | 2244 First Avenue South |

# Snow Fell on Alabama



## EVEN WHERE WINTERS ARE MILD, IT PAYS TO USE 'INCOR'

YES, it does snow in Alabama, sometimes — see top of canopy and truck, above — presenting cold-weather concreting problems, even where winters are mild.

Cars on railroad track (in foreground) blocked trucks at Birmingham Paper Company's loading platform, and parked trucks prevented use of tracks. But track removal and re-paving with ordinary cement meant putting the loading platform out of use for nearly a week.

So 'Incor' concrete was placed, on a Thursday afternoon in late December. In spite of snowy temperatures, heavy trucks rolled safely over freshly-placed 'Incor' concrete early Saturday morning. Birmingham Paper Company officials credit 'Incor' with a substantial cost saving because business wasn't tied up waiting for concrete to harden. Protection against cold-weather hazards was an added and even greater advantage.

'Incor' attains service strength and is beyond freezing danger in one-fifth the usual time. That means a 60 to 70 per cent saving in heat-protection costs—reduced form costs —uninterrupted job progress, even in sub-freezing weather— steadier work for labor—reduced overhead expense through earlier completion. Figure these advantages on work about to start or already in progress. You will find that it pays and pays well to use 'Incor'.*

Made and sold by Lone Star Cement Corporation, 342 Madison Avenue, New York . . . sales offices in principal cities.

*Reg. U. S. Pat. Off.

## 'INCOR' 24-HOUR CEMENT

# "Look what the *winners** used!"

GREYHOUND used Texaco. So did Motor Transit, San Antonio, and Oshkosh.*

You can make maintenance records, too — in your own trucks—with this New Texaco Motor Oil. You will use less oil . . . get lower fuel consumption . . . because . . .

Made by the New Texaco Furfural Process, it is cleansed of all harmful gum, sludge, and carbon forming elements. More bus-miles are lubricated with Texaco Products than with any other brand. The same economies are possible in your trucking equipment, too.

A Texaco representative will be glad to provide practical engineering service to prove the economies of Texaco Products.

THE TEXAS COMPANY · 135 East 42nd St., N. Y. C.
*Nation-wide distribution facilities assure prompt delivery*

***The 1936 Bus Maintenance Award Winners***

Each year the publication Bus Transportation awards gold, silver, and bronze medals to the Bus Operators who have made the greatest reduction in maintenance costs. In 1936 the winners were:

GOLD—Greyhound Management Co. *Cleveland, Ohio*
GOLD—Motor Transit Co. *Jacksonville, Fla.*
SILVER—De Camp Bus Lines *Livingston, N. J.*
SILVER—San Antonio Public Service Co. *San Antonio, Texas*
BRONZE—Oshkosh City Lines, Inc. *Oshkosh, Wis.*

*New*
# TEXACO MOTOR OIL

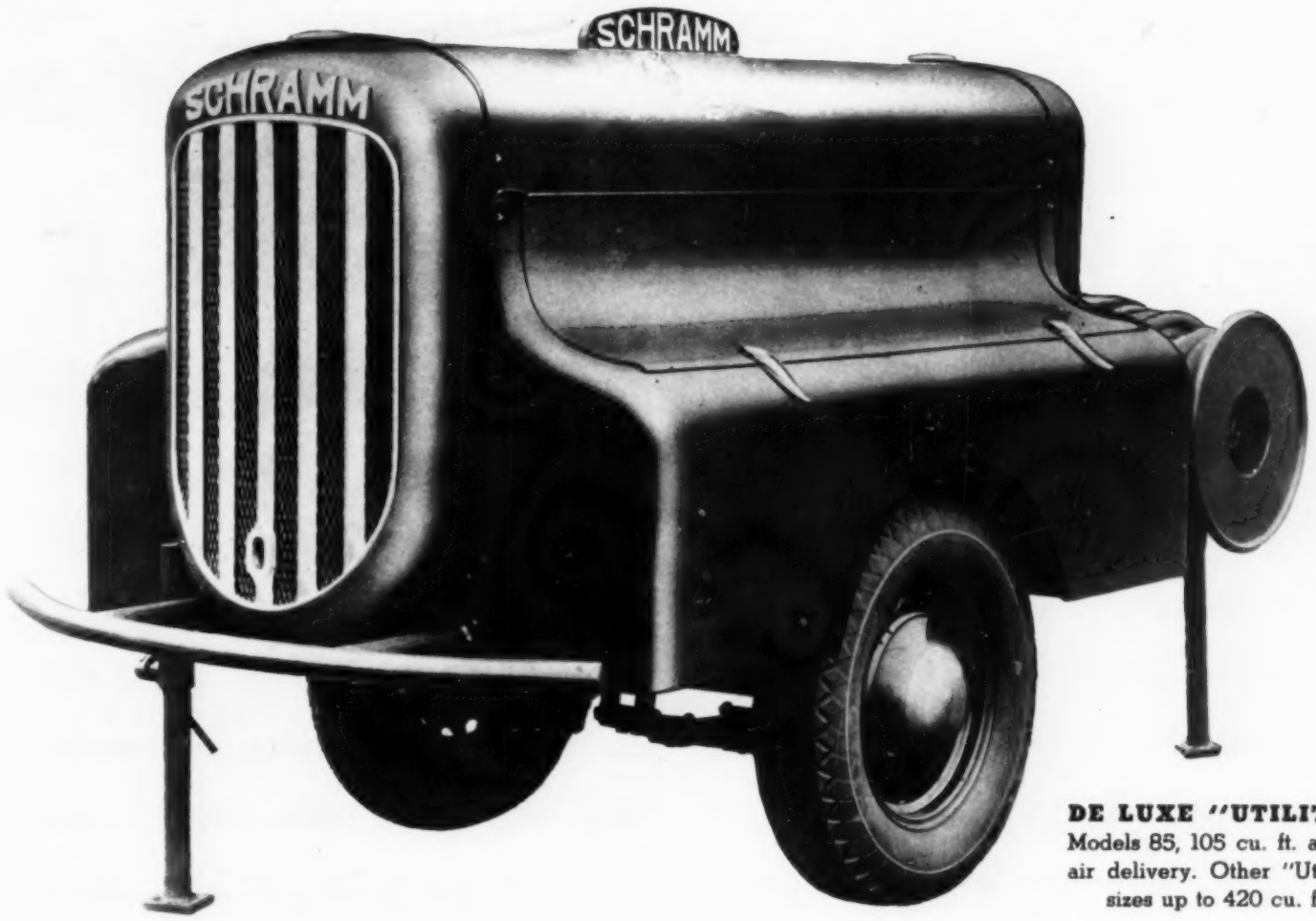
# modern to the minute!

## ROAD SHOW

See for yourself—the "world's most modern air compressor". . . Visit SCHRAMM Booths **A-30-31** Let the SCHRAMM De Luxe "Utility" tell its own story.

DE LUXE "UTILITY" COMPRESSORS—streamlined, lightweight, compact, easy to handle, engineered for the modern contractor that wants to SAVE in transportation costs.

SCHRAMM "Utility" Compressors establish new records of compressor performance—both to the job and on the job. They are the lightest package of air power built today.




**DE LUXE "UTILITY"**
Models 85, 105 cu. ft. actual air delivery. Other "Utility" sizes up to 420 cu. ft.

**SCHRAMM, INC., WEST CHESTER, PENNA.**

# SCHRAMM AIR compressors

# BUILT TO OUTPERFORM IN EVERY KIND OF SOIL

Independently powered for raising pan and operating doors... the A-W 12-yard Scraper never saps the tractor power needed for its tough pulling job. There are no slow-downs or stalls to cut down yardage or tractor speed.

Quick, positive hydraulic operation by scraper's own motor is by remote control from tractor. Superior three-point suspension gives extra flexibility. Unusual strength and lightness secured through the use of tough alloy steels.

Send coupon for full engineering details and production records. They will show what the 12-yard Scraper can give you in added yardage and profits on future earth moving jobs.

**THE AUSTIN-WESTERN ROAD MACHINERY CO.**
**AURORA • ILLINOIS**

# Get EXTRA YARDAGE.. LOWER COSTS.. WITH AUSTIN-WESTERN SCRAPERS

## GIANT RIPPER

### No Scarifying Job Too Tough . . .

Can be used with efficiency wherever there is extra hard scarifying to be done. It will operate in any material which teeth can enter . . . anywhere the most powerful tractor can pull it. Teeth are raised and lowered hydraulically. Hydraulic cylinder actuated by a pump connected to engine mounted on the Ripper tongue, controlled from tractor driver's seat. Check coupon for full details.

**Austin-Western**

**THE AUSTIN-WESTERN ROAD MACHINERY CO., A-6, Aurora, Ill.**

☐ Send a salesman.

Tell me more about the

- ☐ 12-Yd. Scraper
- ☐ Motor Grader
- ☐ Roll-A-Plane
- ☐ Bituminous Distributors
- ☐ Motor Sweeper
- ☐ Crushing & Washing Plants
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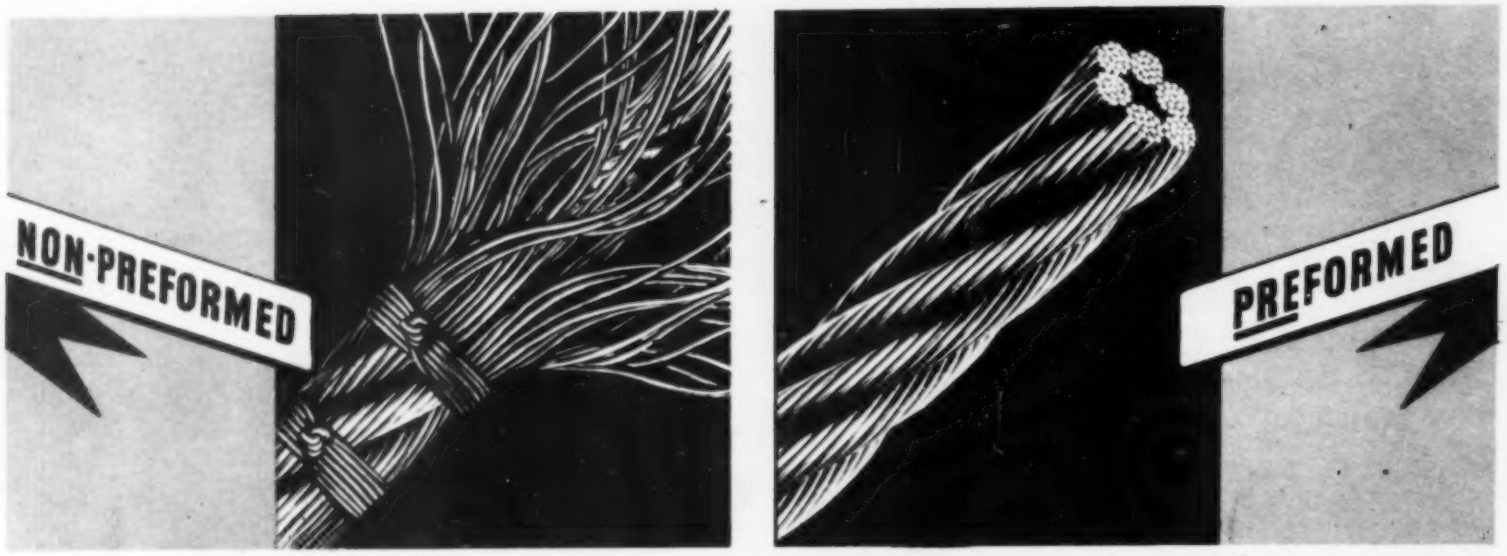
- ☐ Blade Grader
- ☐ Snow Plows
- ☐ Elevating Graders

*Name* .....

*Address* .....

*City* ..... *State* .....

S-703-C




# THERE ARE SEVERAL REASONS WHY WE RECOMMEND *Preformed* WIRE ROPE

The foremost reason for recommending preformed wire rope is that for many applications it gives much *greater dollar value. . . .* But there are many other reasons, too. For one: it is *safer* for the workmen to handle. Broken crown wires don't bristle out to jab men's hands. Then too, the preforming process tends to *eliminate the destructive internal stress.* This elimination also means that preformed rope . . .

- **requires no seizing**
- **resists kinking**
- **is easier to splice or socket**
- **is much easier to handle**

**AMERICAN CABLE COMPANY, INC.**
**AMERICAN STEEL & WIRE COMPANY**
**BRODERICK & BASCOM ROPE CO.**
**COAST CABLE COMPANY**
**E. H. EDWARDS COMPANY**
**HAZARD WIRE ROPE COMPANY**
**A. LESCHEN & SONS ROPE COMPANY**
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**ROCHESTER ROPES, INCORPORATED**
**JOHN A. ROEBLING'S SONS COMPANY**
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**WICKWIRE SPENCER STEEL COMPANY**
**WILLIAMSPORT WIRE ROPE COMPANY**
**WIRE ROPE CORPORATION OF AMERICA**
**WIRE ROPE MANUFACTURING & EQUIPMENT CO.**

# BLAW-KNOX *in the front line of 1937 construction*

CONCRETE BUCKETS

CLAMSHELL BUCKETS

BOTTOMLESS SCRAPERS

BULK CEMENT PLANTS

SHEEPS-FOOT TAMPING ROLLERS

TRUCK MIXERS

ROAD FINISHING MACHINES

STEEL FORMS *for General Concrete Construction*

BATCHER-PLANTS

STEEL STREET FORMS

*NEW* ROAD FORMS

The *choice of experience* is an intelligent guide to equipment buying.

—for thirty years the design of Blaw-Knox Road Building Equipment has progressed with the industry to produce more efficient and time saving equipment.

It is new—better—always improved to meet the peak demands of modern road building.

—for 1937, join with Blaw-Knox in the front line of construction.

**BLAW-KNOX COMPANY**
2086 Farmer's Bank Building • Pittsburgh, Pa.
OFFICES AND REPRESENTATIVES IN PRICIPAL CITIES

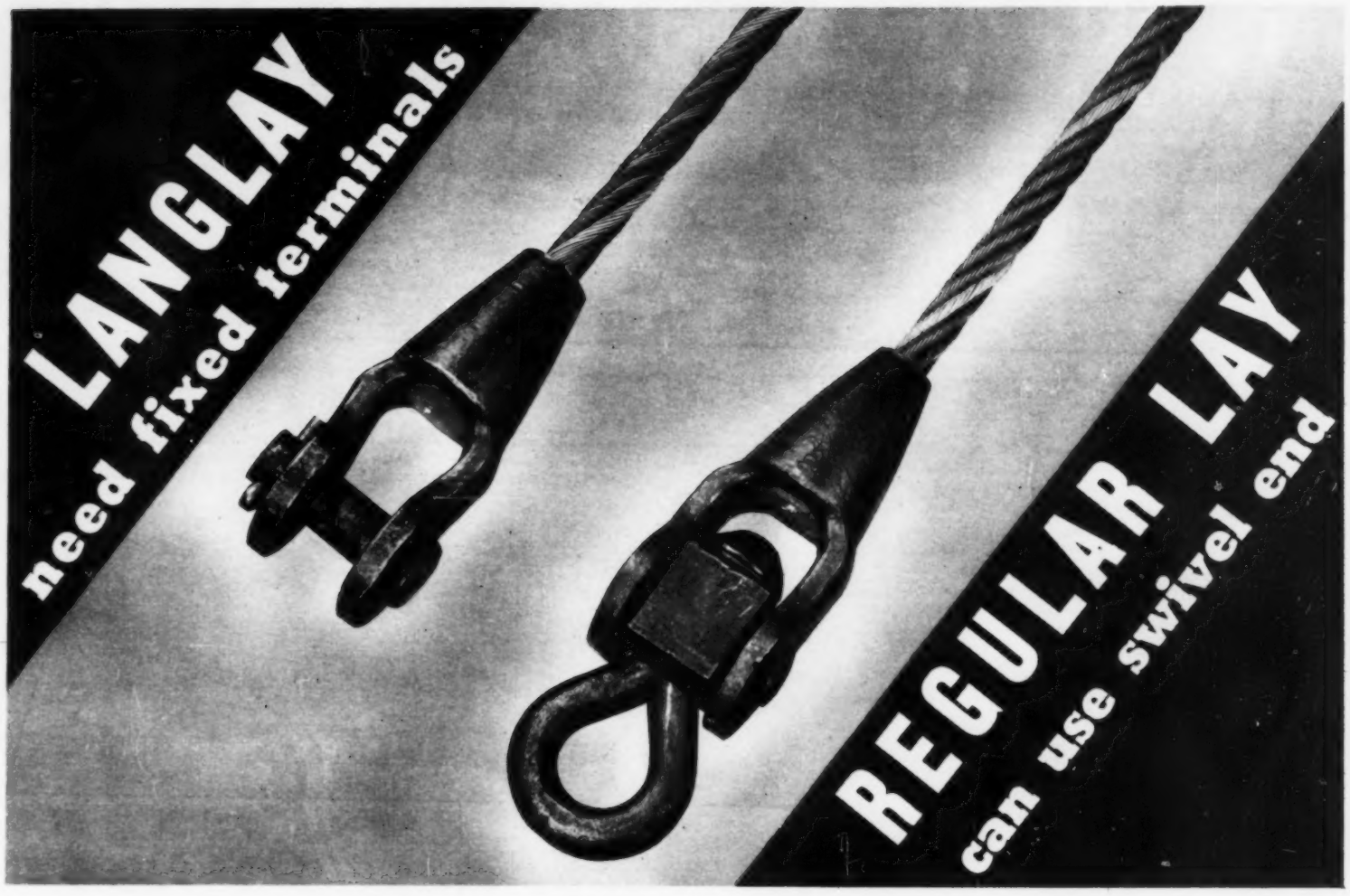
See the BLAW-KNOX exhibit at the ROAD SHOW New Orleans, La. January 11th to 15th 1937

# MAC O'MATIC AND HIS Speed-o-Matic

SAY, MAC, HOW DID YOU MAKE SUCH A WONDERFUL RECORD ON THE SMITH JOB. OUR COSTS ARE ALMOST TOO LOW TO BELIEVE!
WELL, WE USED OUR NEW SPEED-O-MATIC ON THAT JOB
1
SHOW ME — I WANT TO KNOW ABOUT ANY EQUIP-MENT THAT CUTS COSTS!
IT'S THE MOST REMARKABLE SHOVEL I'VE EVER SEEN— FEWER PARTS TO GET OUT OF ORDER, TOO!
2
WELL WHAT DO YOU THINK OF IT?
GREAT SCOTT! LOOK AT THE SPEED OF THAT MACHINE! NO WONDER YOU CUT COSTS!
3
THESE SHORT, EASY-MOVING LEVERS DON'T TIRE ME LIKE THOSE OLD HAND LEVERS. IT'S AS EASY AS DRIVING A CAR!
NICE, EASY SEAT YOU'VE GOT, TOO!
4
I'M CONVINCED! WE'RE GOING TO REPLACE OUR OLD SHOVELS WITH SPEED-O-MATICS! WE'LL LAND MORE JOBS!
---AND MAKE MORE PROFIT, TOO!
NOT BAD NEWS FOR THE OTHER OPERATORS
5
YEAH, I HEARD THE BOSS SAY — NOTHING BUT SPEED-O-MATICS FROM NOW ON!
GOOD LUCK FOR MY OLD BACK!
THAT'S THE BEST NEWS I'VE HEARD SINCE YOU OFFERED TO TREAT!
6

Speed-o-Matic Effort-les Control results in outputs so greatly increased, that claims based on actual data would appear extravagant. A visual demonstration is necessary for an appreciation of the astonishing results that are now obtainable. Address Link-Belt Company, 300 W. Pershing Road, Chicago. Offices and distributors located in principal cities. 1097

# LINK-BELT Speed-o-Matic
## SHOVELS—DRAGLINES—CRANES




*Select the Rope that Fits Your Job*

Langlay wire rope will give a longer life over small sheaves than Regular Lay rope of identical grade and construction. Langlay rope, however, has one definite disadvantage. It is made by twisting all individual wires and strands in the same direction thus causing a very decided tendency of the rope to unlay itself. A Langlay rope can only be used when both terminal ends of the rope are fixed. Never use a Langlay rope for a spinning load or with a swivel terminal. Let us know the nature of your service for wire rope and we will gladly recommend a construction that will give the longest possible life.

•

WICKWIRE SPENCER STEEL COMPANY, *General Offices:* 41 East 42nd Street, New York. *Sales Offices and Warehouses:* Worcester, New York, Chicago, Buffalo, San Francisco, Los Angeles; *Export Sales Dept.:* New York.

WICKWIRE SPENCER SALES CORPORATION, New York, Chattanooga, Tulsa, Portland, Seattle.

# WIRE ROPE by Wickwire Spencer

WICKWIRE SPENCER STEEL CO.
41 East 42nd St., New York City
Please send me reprints of previous advertisements which tell "How to make Wire Rope last longer".

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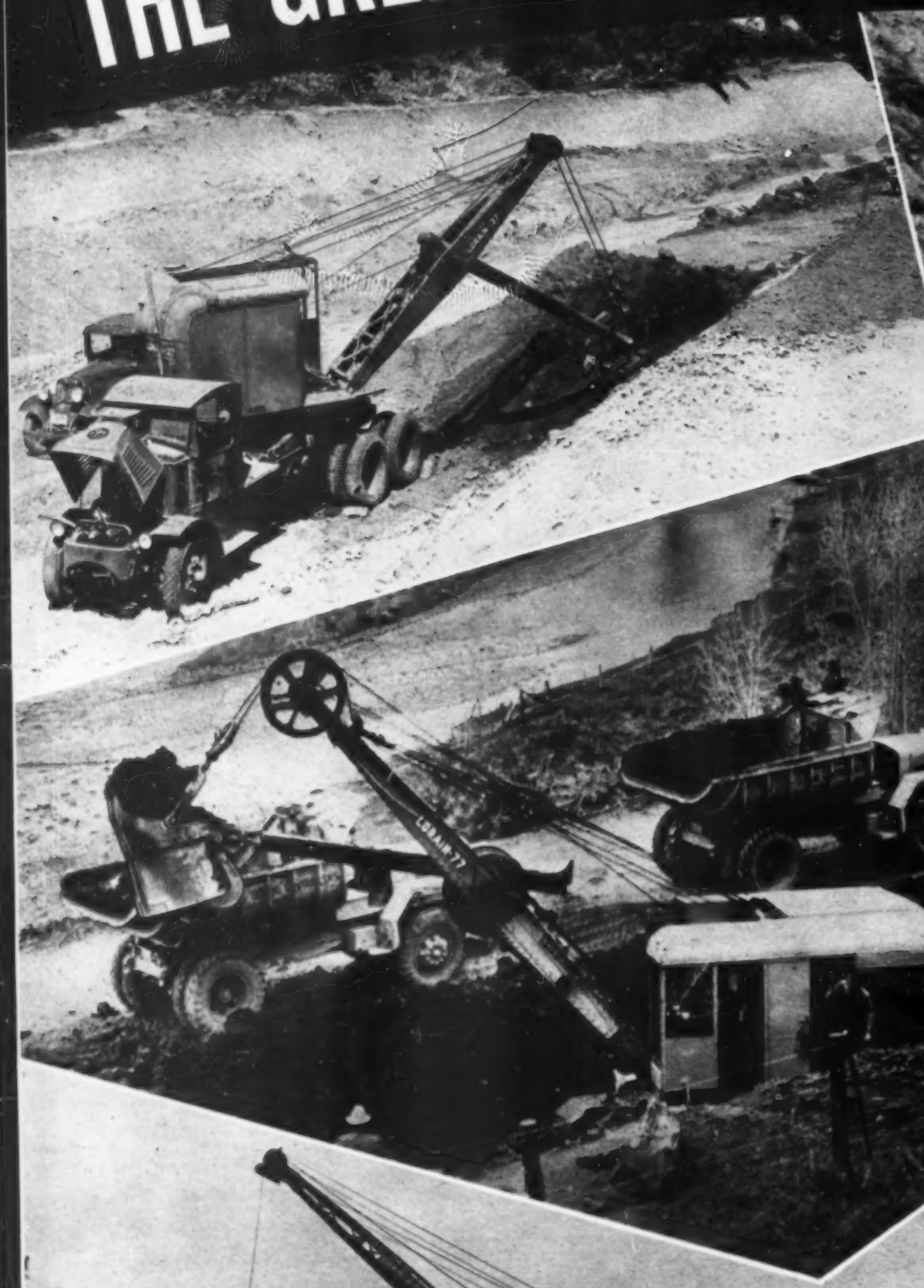
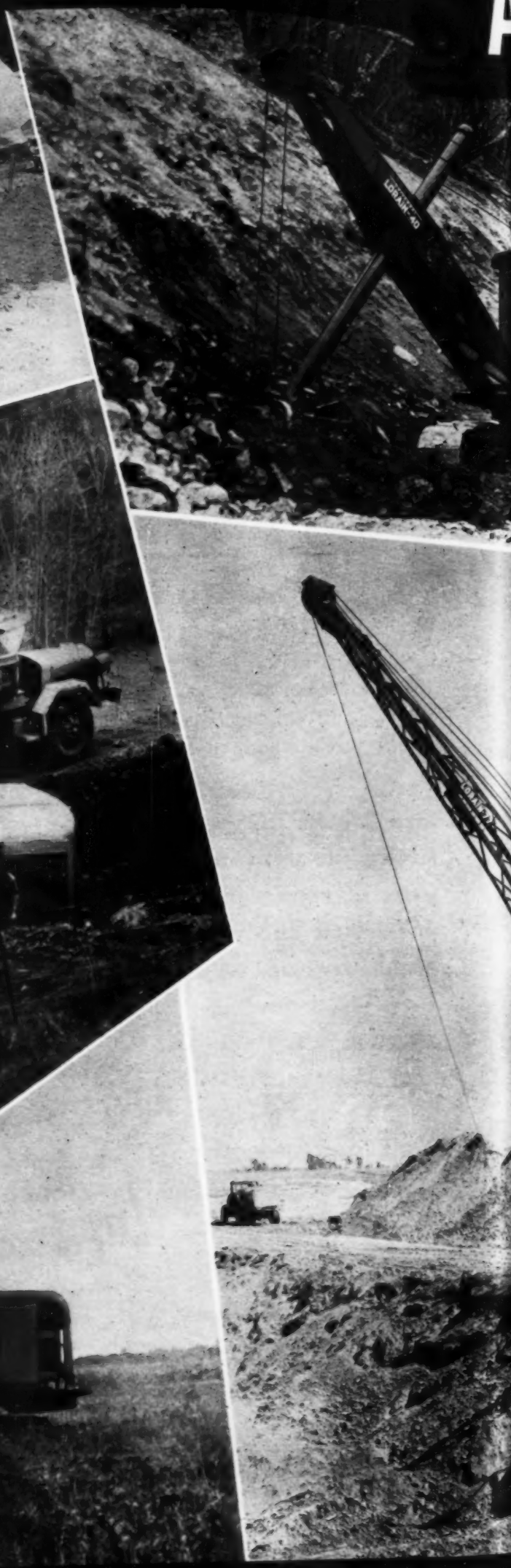
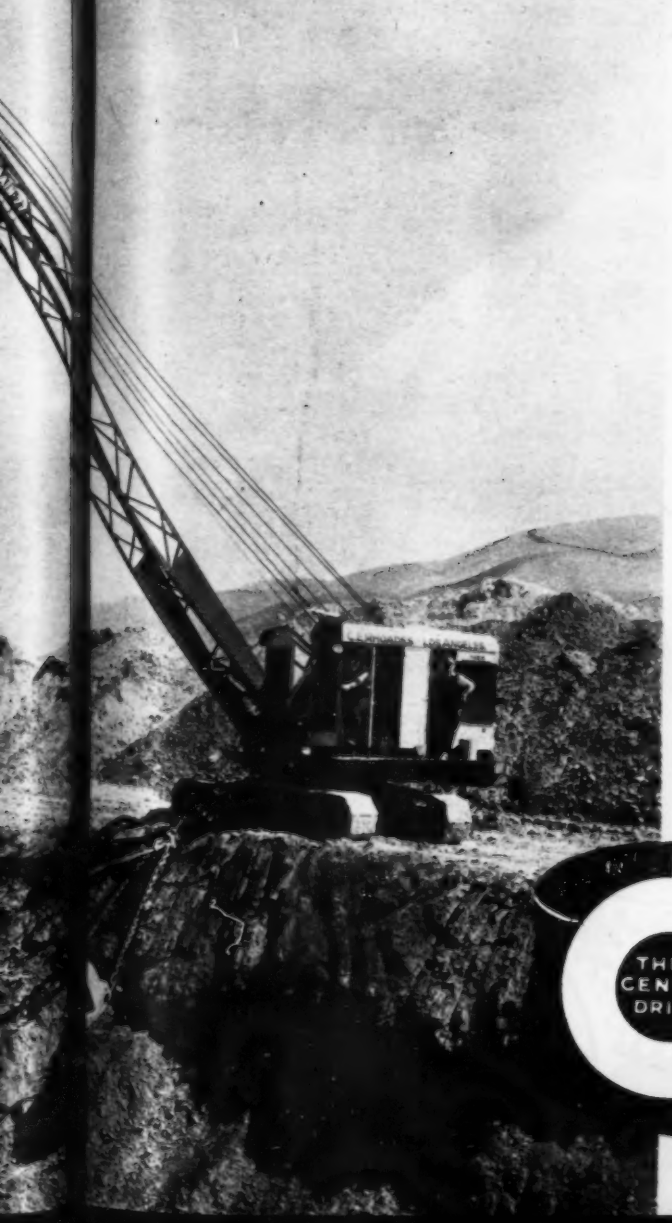
# THE GREATEST SPECIFICATION



# A SHOVEL OR CRANE CAN HAVE



**S**tep into the cab of any Lorain, talk to the operator—and the man who owns it—they will tell of Lorain performance and profit records that will convince any contractor, with an eye on profits, that "Center Drive is the *Greatest Specification a Crane or Shovel Can Have.*"

Step into the cab of any Lorain and you'll soon know what Center Drive means—a short cut from motor to smooth, powerful operations; rugged strength for extra heavy-duty service and long relentless grinds; a shovel boom with exceptional ranges; a two speed crawler, simple in design, agile and powerful in use . . . You'll realize that here is a shovel and crane designed to earn profits not only for 1937, but for many years to come.

**THE THEW SHOVEL CO., LORAIN, O.**

**THE UNIVERSAL CRANE CO.**

THEW CENTER DRIVE

**LORAINS**

MOVE MORE MATERIAL, FASTER AT LOWER COST

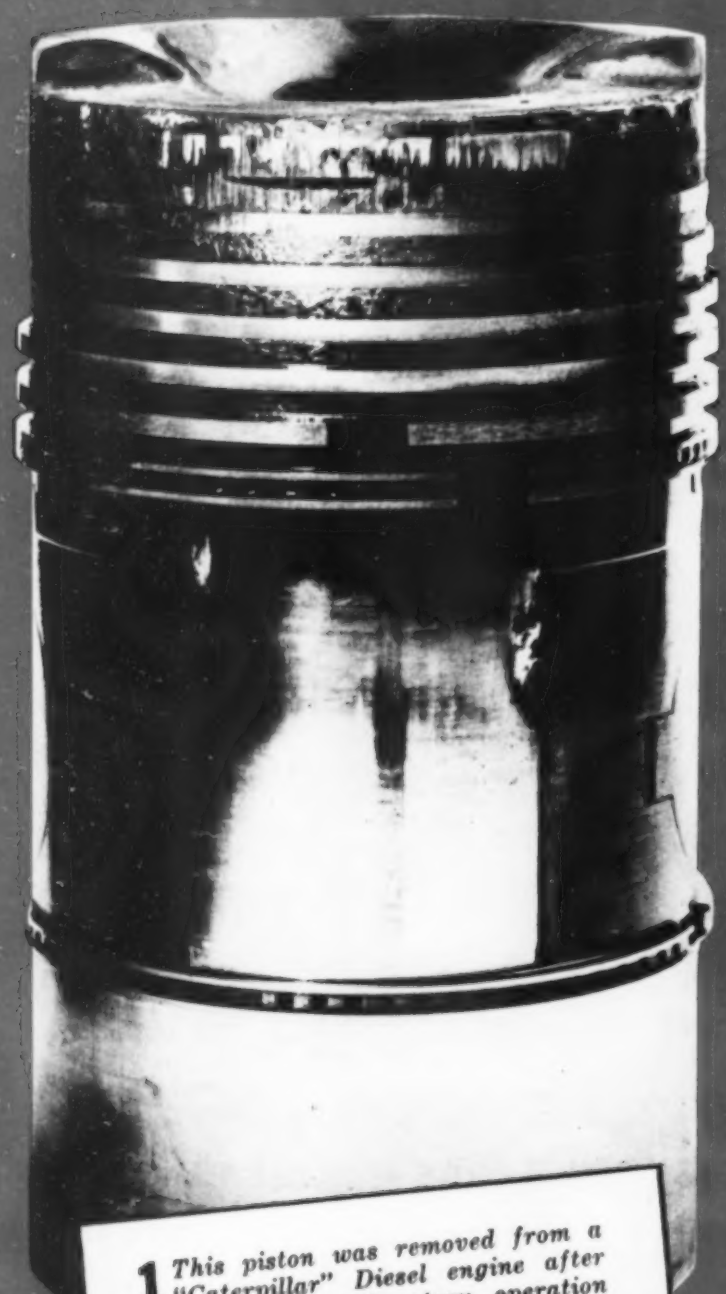
**CU. 3/8 to 2 YD.**

# 10 TIMES MORE Diesel

**Sinclair Ten-ol is a special alloyed lubricating oil developed for "Caterpillar" Diesel engines by Sinclair Refining Company. During the past several months this new Diesel lubricant has been put through exacting research laboratory and field tests.**

**In full power comparative laboratory tests, "Caterpillar" Diesel engines lubricated with Sinclair Ten-ol gave ten times as many service hours without shutdown as the finest straight mineral oils. In the average of all tests, consumption of Ten-ol was approximately one-half that of high grade mineral oils. In one of the tests a Diesel lubricated with Sinclair Ten-ol operated at extremely high overload with no damage to the engine and all lubricated surfaces kept in perfect condition.**

**Below are authentic photographs of test pistons**



**1** *This piston was removed from a "Caterpillar" Diesel engine after an accelerated laboratory operation test. A poor grade of straight mineral oil was used throughout the test. Note the badly stuck rings which caused loss of compression, blow-by and excessive ring wear. Serious oil pumping was also caused by badly plugged oil control rings.*

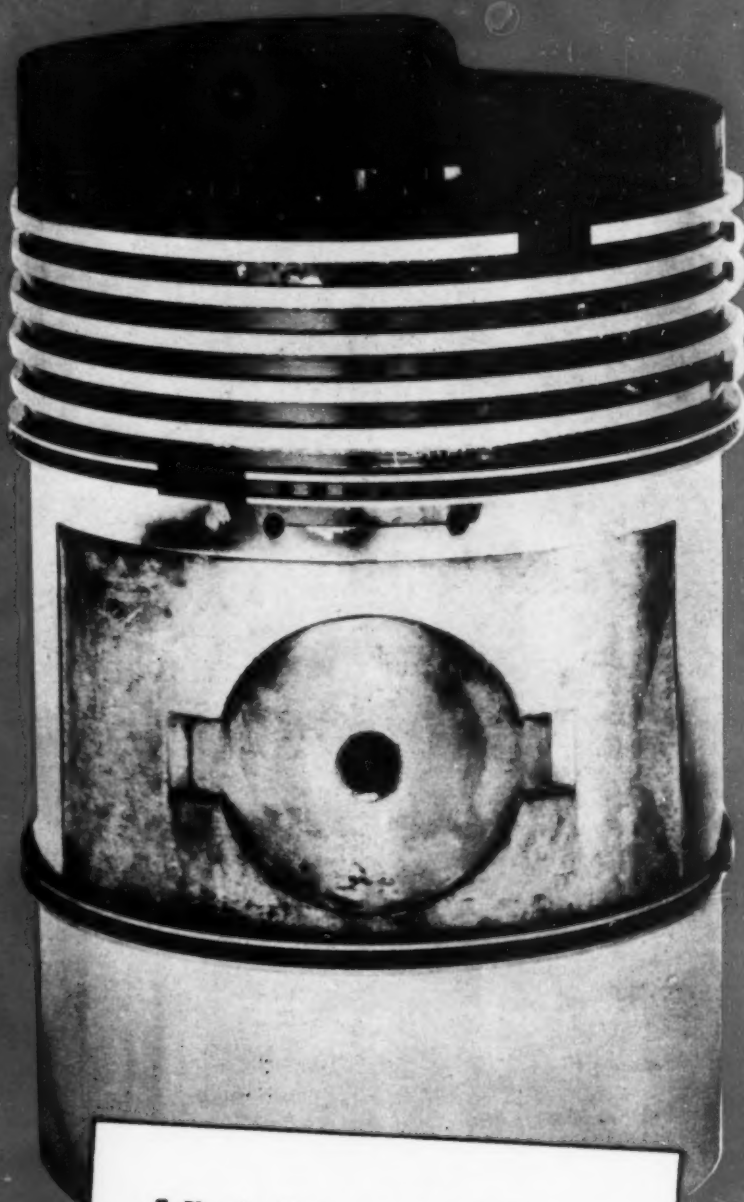
**2** *The finest grade of straight mineral oil was used to lubricate this piston in the same Diesel engine during an accelerated operation test of the same duration as No. 1. Poor piston seal is indicated by signs of excessive blow-by. Note the carbon-coated piston crown, sludge, plugged oil control rings and gum on piston skirt. Wear on liners is still excessive.*

# service hours with SINCLAIR TEN-OL

taken after exacting laboratory tests. The piston photos have *not been retouched.* Read the captions under each photo—they tell the remarkable story of Sinclair Ten-ol's outstanding superiority. It will mean a tremendous saving in your own Diesel operation.

Sold by your local Sinclair representative.

**3** *This piston was removed from a "Caterpillar" Diesel after an accelerated operation test* ten times as long *as that of No. 1 and No. 2 on the left. Sinclair Ten-ol lubricated the Diesel throughout the test. Note the absence of ring-sticking, the perfect condition of oil-control rings, freedom from blow-by and absence of gum on piston skirt. Ring and liner wear are negligible.*



**4** *Here's the front side of the same piston (No. 3) after the test with Sinclair Ten-ol. Note that all piston rings are clean and move freely. Experts pronounce this the cleanest, most perfect Diesel lubrication job ever obtained.* Sinclair Ten-ol multiplies Diesel service hours by ten!

**Sinclair Ten-ol is recommended as a "New Outstanding Diesel Engine Lubricant" by the Caterpillar Tractor Co.** Order Sinclair Ten-ol, Sinclair Diesel fuel and other Sinclair products from your local Sinclair office or write Sinclair Refining Company, 630 Fifth Avenue, New York City.

*Copyrighted, 1937, by Sinclair Refining Company (Inc.)*

# Mud or

**MUD!** It's muddy on this excavation contract at Tygart Dam in Maryland—but not too muddy for the "Caterpillar" Diesel Tractor. The contractor has six "Caterpillar" Diesels on this job and it takes more than a cloudburst to keep them from earning their way every day.

# CATERPILLAR

REG. U. S. PAT. OFF.

**CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS**

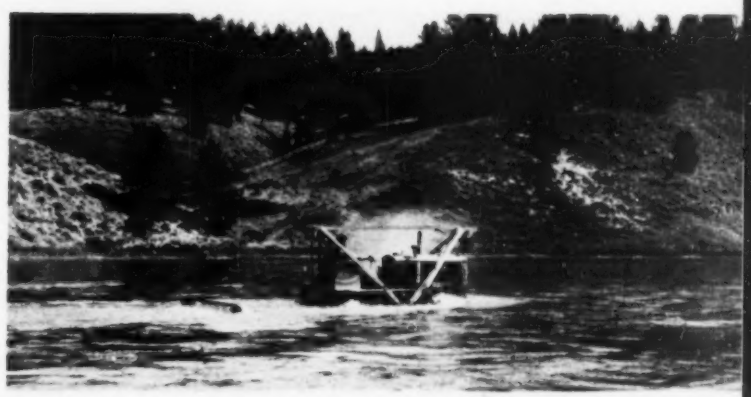
# dust...

# DO NOT HOLD UP "CATERPILLAR" DIESEL JOBS

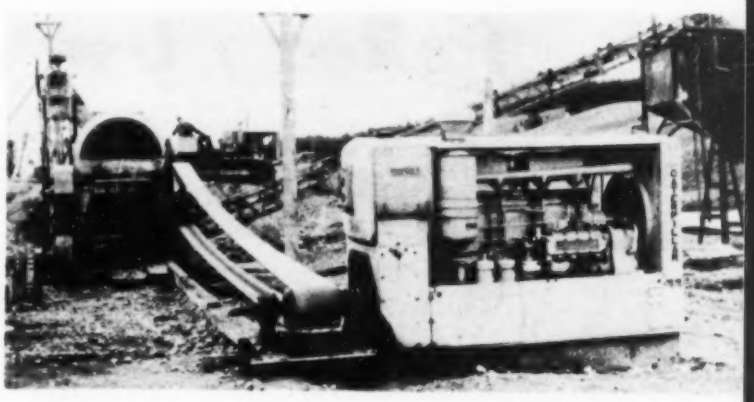
There are plenty of tough construction jobs today—but they are not too tough for the "Caterpillar" Diesel Tractor. Long hours, heavy loads, bad weather and ground conditions will not delay the job when "Caterpillar" Diesels are doing the work. And every hour, every day, means more dollars of "Caterpillar" Diesel savings.

Thousands of "Caterpillar" Diesel Tractors have proved that no other tractor power can compete with them. Find out what they can do for *you*. There's a "Caterpillar" dealer near you—with trained service men and stocks of machines and parts.

**DUST!** It's dusty on this coal mining operation in Pennsylvania—but not too dusty for the "Caterpillar" Diesel Tractor. It hauls its wagon-loads of overburden day after day—even when the operator has to wear a mask.



**GOING AFTER GRAVEL** They had to go to the river-bed to get gravel for a Yellowstone Park Highway—and a "Caterpillar" Diesel Tractor goes after it. Tough—but not too tough a job for the "Caterpillar" Diesel. Trip after trip, day after day, it carries scraper-loads to the "Caterpillar" Diesel-powered crusher (below). This team cuts gravel costs to a figure heretofore thought impossible, and its steady, reliable production makes the best of a short road-building season.



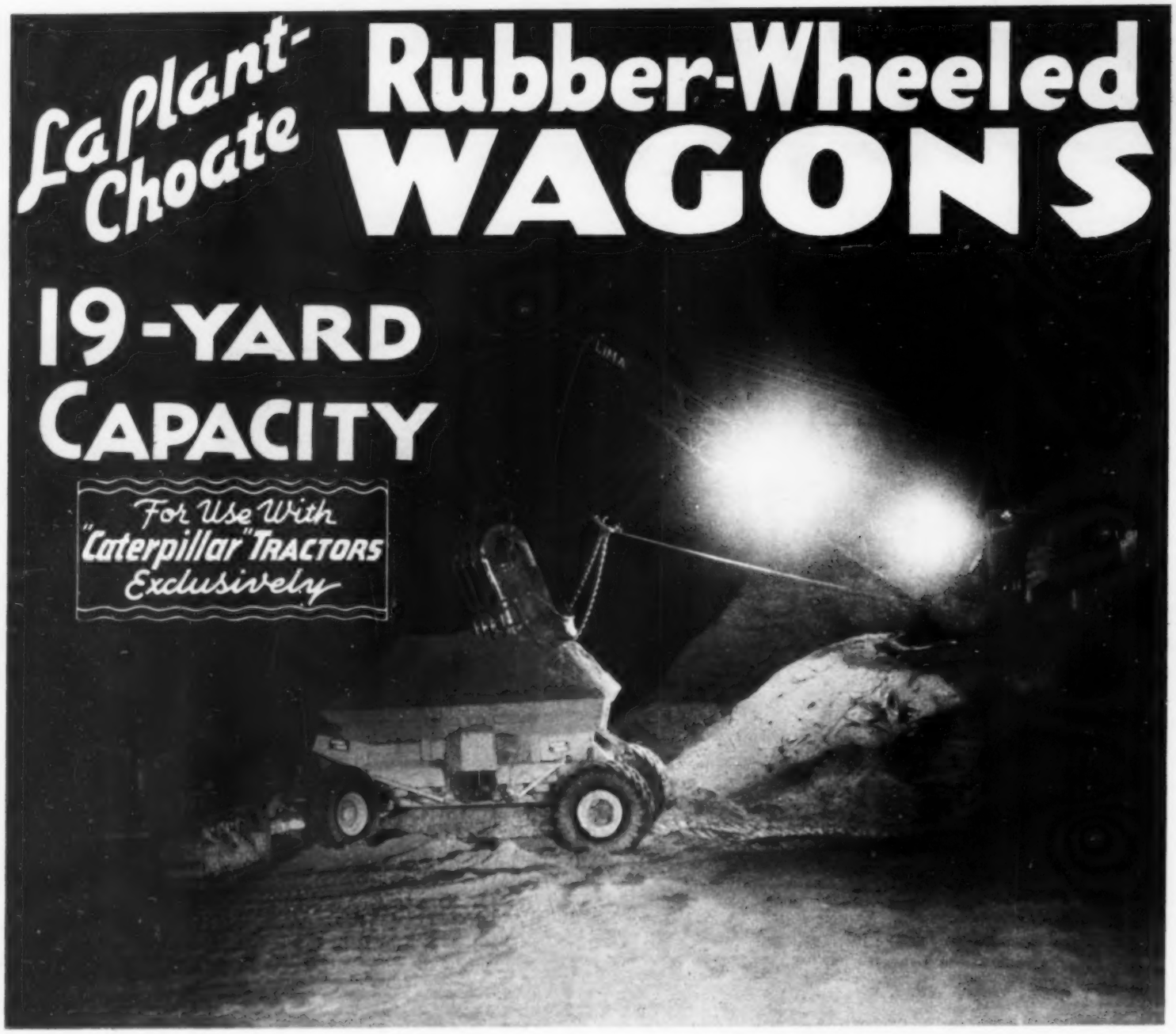
**WORLD'S LARGEST MANUFACTURER OF DIESEL ENGINES, TRACK-TYPE TRACTORS AND ROAD MACHINERY**

LaPlant-Choate

# Rubber-Wheeled WAGONS

## 19-YARD CAPACITY

For Use With "Caterpillar" TRACTORS Exclusively



## SUCCESSFUL BIDDING
## *Reflects Use of Modern Equipment*

LaPlant-Choate Rubber-Wheeled Wagons are designed for hauling bigger loads with the same power. These wagons roll easily, make short turns, negotiate any surface; in brief, they reduce the cost per yard of hauling. For speed, traction, capacity, low upkeep and repair costs, this is the wagon for the contractor who wants to maintain a secure position in the competitive picture. LaPlant-Choate Rubber-Wheeled Wagons have been released for sale only after eleven months' test on five different construction jobs. Not an experiment but a thoroughly proven product! For full information, consult your Caterpillar dealer or write to LaPlant-Choate Manufacturing Company.

**HYDRAULICALLY CONTROLLED**

**SCRAPERS • SNOW PLOWS • BULLDOZERS • ROAD BUILDERS • BRUSH CUTTERS • TAMPING ROLLERS**

*LaPlant-Choate Mfg. Co. Inc.*
**CEDAR RAPIDS, IOWA**

**PUT THE LeTOURNEAU TYPE "U" CARRYALL TO WORK WITH YOUR TRACTOR**

# GET 50% MORE YARDAGE

## from the same power source . . .

**Today's lowest earthmoving costs are obtained by the use of LeTourneau Carryall Scrapers and Diesel tractors. The experience of more than 1500 users has job-proved that statement. Now, with the introduction of the LeTourneau Type "U" Expanding Carryall Scraper, even lower costs are possible. The bowl of this new and advanced scraper consists of two buckets, one of which telescopes within the other. When loading, the rear bucket is pushed back by the incoming material, resulting in an increase of 50% or more in yardage at no increase in tractor power. Ask your Caterpillar dealer for further details about the LeTourneau Type "U" Expanding Carryall Scraper.**

## R. G. LE TOURNEAU, INC.

PEORIA, ILLINOIS — STOCKTON, CALIFORNIA

*Cable Address:* "Bobletorno"

*Manufacturers of:* Angledozers*, Buggies*, Bulldozers, Carryall* Scrapers, Cranes, Drag Scrapers, Power Control Units, Rooters* and Semi-Trailers.
**Name registered U. S. Patent Office.*

**Made in four sizes:**

18-Yard — for Caterpillar RD8
12-Yard — for Caterpillar RD7
9-Yard — for Caterpillar RD6
6-Yard — for Caterpillar RD4

*Above* — The new 18-Yard Expanding Carryall unloading. It has the same positive, cable-actuated tailgate method of unloading as the 1500 Carryalls that have preceded it.

*Left* — 12-Yard Expanding Carryall loaded. Big pneumatic tires enable it to work where other equipment bogs down.

**LETOURNEAU**

# ♫ If your shovel could sing ♫

WHEN the bucket is full—the rhythm of the shovel bucket as it swings from fill to dump sings a smooth song of profitable operation.

It is blasting that controls the full bucket. Good blasting speeds production; insures full bucket-loads; keeps trucks moving. Poor blasting invariably decreases average yardage, hinders loading.

One survey of methods is typical. With better blasting a group of contractors increased dipper load movements from 55.4 loads per hour to 87.6 loads; average yardage from 35 cu. yds. per hour per shovel to 69.7 cu. yds. Good blasting makes money; poor blasting loses it.

There is an Atlas Explosive designed to meet every construction blasting problem. The Atlas representative is competent to recommend the right explosive for the job. He will gladly consult with you to put technical experience at your disposal to meet your individual problems. Write the nearest Atlas office.

## ATLAS POWDER COMPANY, WILMINGTON, DEL.

**Cable Address—Atpowco**

*Everything for Blasting*

**OFFICES**

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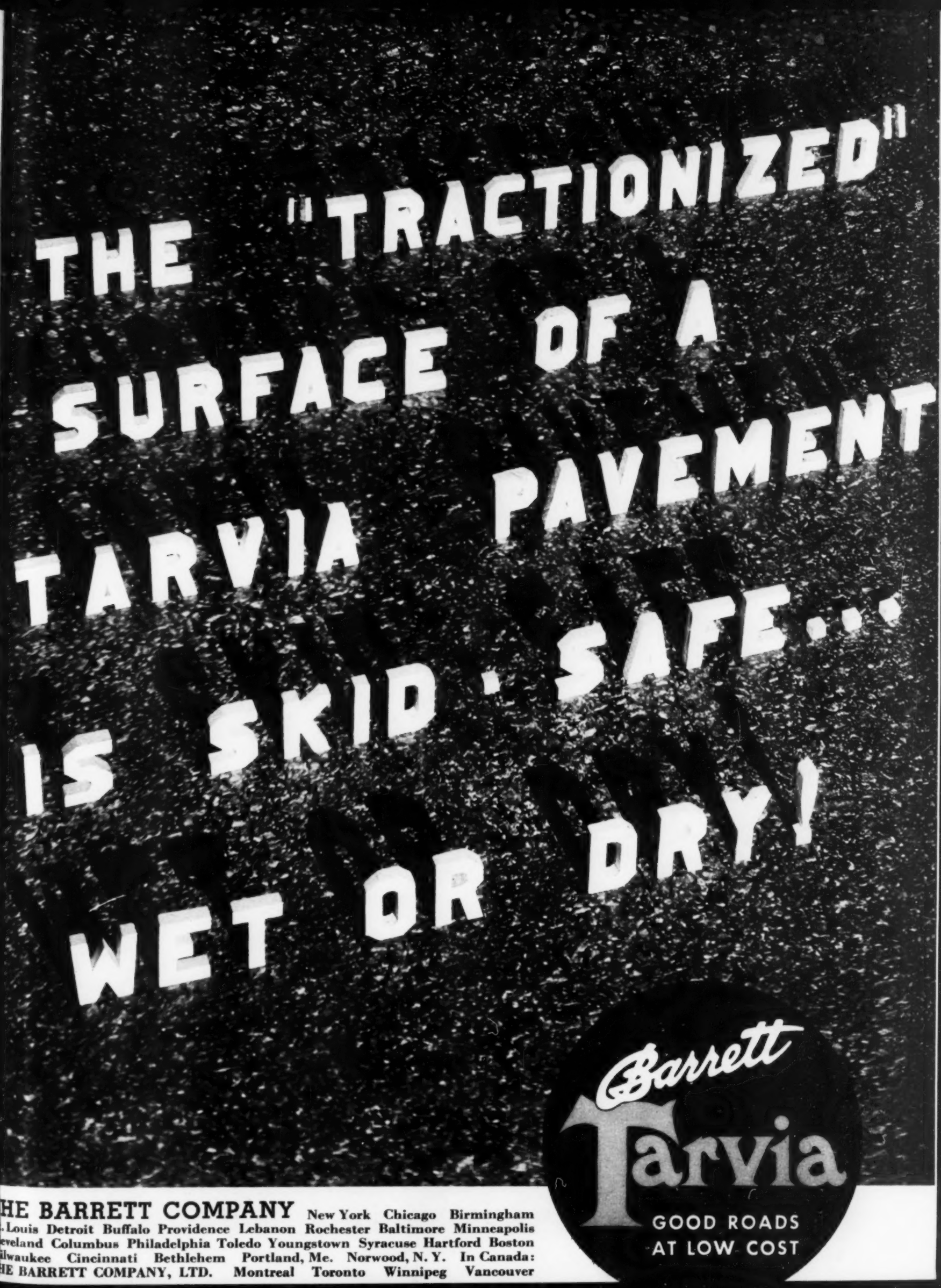
# ATLAS

EXPLOSIVES

CHEMICALS ATLAS EXPLOSIVES




THE BARRETT COMPANY New York Chicago Birmingham
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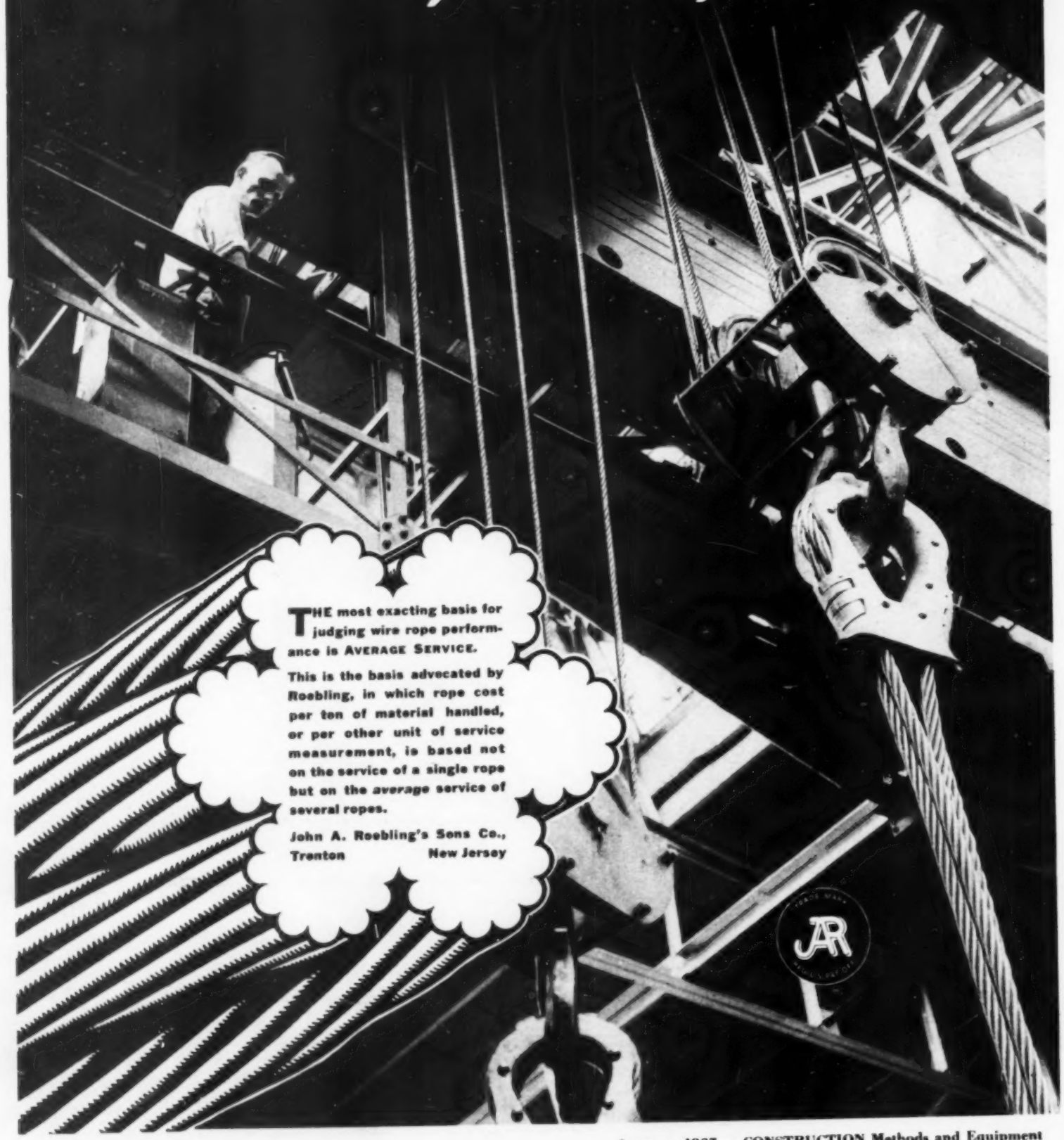
THE BARRETT COMPANY, LTD. Montreal Toronto Winnipeg Vancouver

# *Roebling...*

## *The pacemaker in wire rope development*



**THE most exacting basis for judging wire rope performance is AVERAGE SERVICE.**

**This is the basis advocated by Roebling, in which rope cost per ton of material handled, or per other unit of service measurement, is based not on the service of a single rope but on the *average* service of several ropes.**

**John A. Roebling's Sons Co., Trenton New Jersey**

# "Better than 1,000 cu. yds. in 8 hours on 5% Grade . . ."

HERE'S THE WAY JAEGERS PAY

WESTERN UNION

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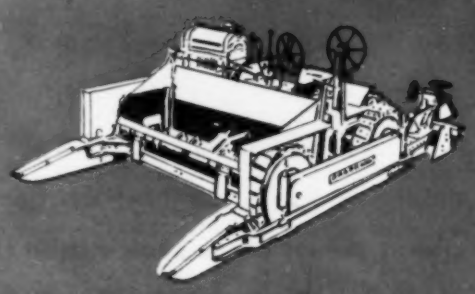
QUIPMENT CO=
TLAKECITY UTAH= XC 16

IN JUNE NINETEEN THIRTY FIVE WE ACCEPTED DELIVERY OF ONE JAEGER PAVER AT SALEM OREGON THE SAME BEING USED IN LAYING THE BASE COURSE OF BITUMINOUS MACADAM THIS MACHINE WAS ABLE TO HANDLE BETTER THAN ONE THOUSAND CUBIC YARDS IN EIGHT HOURS ON A FIVE PERCENT GRADE GIVING EXCELLENT WORK AND MET THE APPROVAL OF MR BALDOCK STATE HIGHWAY DEPARTMENT AND MR SMITH OF THE CONSTRUCTION DEPARTMENT AS A MATTER OF FACT IT WAS A COMPLETE SUCCESS WITH OUR ORGANIZATION AS WELL AS THE STATE HIGHWAY DEPARTMENT STOP IN JULY THE MACHINE WAS USED ON TWENTY MILES OF PLANT MIX FOR THE BUREAU OF PUBLIC ROADS AT CRATERLAKE WHERE ITS PERFORMANCE WAS APPROVED BY THEIR ENGINEERS AND OUR ORGANIZATION STOP THE MACHINE GAVE ENTIRE SATISFACTION AND LAID A PAVEMENT WITH EXCELLENT RIDING QUALITIES=

J C COMPTON CO=

# JAEGER *Bituminous* PAVER



Adjustable for Widths to 14 Ft.

No Weight, No Traction on New Road

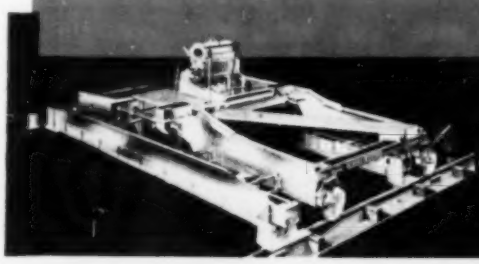
Lays It Smoother, Lays It Faster

On job after job with the Jaeger Bituminous Paver, three things stick out: (1) the unfailing approval of state engineers, (2) the excellent riding qualities of the road: (3) the capacity of the Jaeger Paver to lay huge tonnages in a working day.

Road builders, who know that high production is the key to low costs, will tell you that their Jaeger Pavers lay material faster than their plants can mix it. No matter how sticky the mix, it passes easily thru Jaeger's re-mixing pug-mill spreader. No matter how steep the grade or fast the pace, Jaeger's four semi-crawler wheels, always operating on the hard subgrade, have speed and traction to spare. No creeping or tearing of the new laid surface, because it is never touched by anything except the screeds.

Floating 18 ft. straight edge runners, which carry the screed and blenders, average out all irregularities in subgrade. Blenders complete perfect joints, lay flush to curb, increase built-in adjustability for wider widths, save costly hand finishing. The machine lays the road.

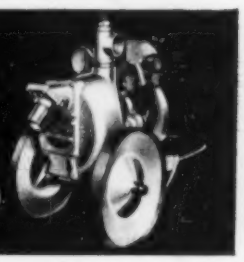
Before you buy any paver, before you bid any job—get our catalog, prices and complete details. THE JAEGER MACHINE CO., 800 Dublin Ave., Columbus, Ohio.



TYPE "D" FINISHERS for Highest Type Concrete, Bituminous Pavements

SPEED KING 10S Bridge Builder Mixers --Other Non-Tilts, Tilters, 3½S to 56S Sizes

SURE PRIME Contractors' Pumps--2" to 10" Sizes, 7,000 to 200,000 G.P.H.



# St. Louis County, Minn.

*Second Largest in the United States*

## STANDARDIZES ON CUMMINS DIESELS

● After a thorough test of THREE Cummins Diesels in highway trucks . . . after testing the Cummins Diesel behind snow-plows during the most severe winter in many years . . . after months of road-work on its 5,000 miles of county-maintained highways . . . .

The Board of St. Louis County passed a resolution that ALL new trucks ordered should be powered with Cummins Diesels . . . and immediately placed orders for four new trucks.

The Board is to be complimented. The tax payers will get the maximum in low-cost truck operation, for *powered by Cummins Diesel* means: ample power, twice the mileage with cheap diesel oil as fuel, instant starting and smooth-running in all kinds of weather, proven dependability and low maintenance costs.

*St. Louis County invites you to spend your summer vacation in the heart of the Arrowhead country . . . to try its 5,000 miles of modern highways*

**CUMMINS ENGINE COMPANY, COLUMBUS, IND.**

# CUMMINS DIESELS

*Pioneers in Modern Diesel Development*

# License plates of 48 States
## pass over this thoroughfare annually

Views of Whirlpool Street, Niagara Falls, N. Y., showing TEXACO Sheet Asphalt pavement under construction and completed.

Newlyweds and plain, ordinary tourists are drawn to Niagara Falls every year from all parts of the United States. To intensify further this concentration of traffic, foreigners from many distant countries also come annually to behold Niagara.

One result of this fame is that Whirlpool Street in the City of Niagara Falls, N. Y. carries a continuous and heavy flow of traffic throughout the summer months. A substantial yardage of Whirlpool Street was paved this year with TEXACO Sheet Asphalt. The resilient, rugged, safe and easy-riding qualities of TEXACO Sheet Asphalt are the sound reasons for its use on heavy-duty streets in hundreds of cities for more than a quarter of a century.

TEXACO

THE TEXAS COMPANY, Asphalt Sales Dept.
135 E. 42nd St., New York City

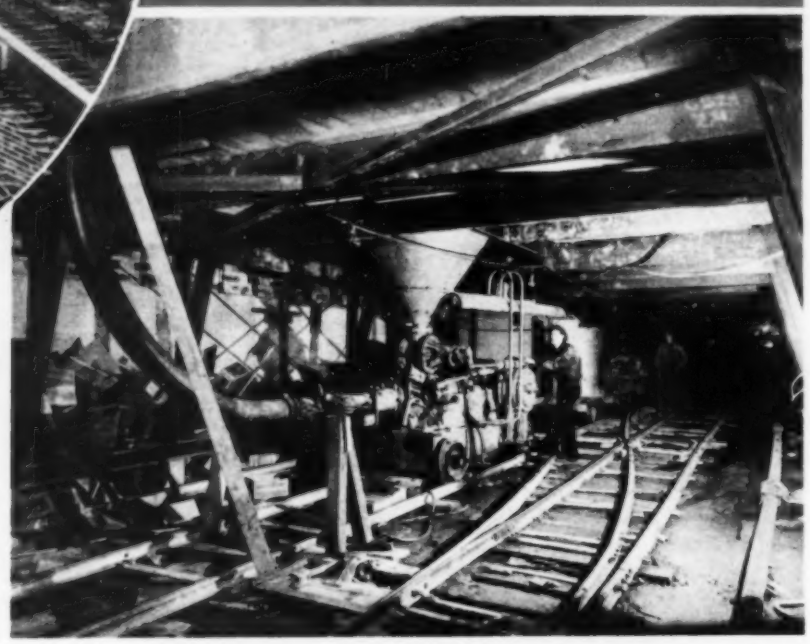
| | | |
|---|---|---|
| Buffalo | Jacksonville | Kansas City, Mo. |
| Philadelphia | Boston | Dallas |
| Richmond | Chicago | Houston |
| | Cleveland | |

# TEXACO ASPHALT

# YOU HAVE TO FORGET THE OLD STUFF *in the face of* 4,000,000 YARDS

*Over*

4,000,000 Yards of Concrete Have Been Pumped into the Forms by the Rex Pumpcrete



*The Rex Pumpcrete pouring ceiling slab on the Manhattan tunnel, New York.*

From New York's Triborough to San Francisco's Oakland Bay Bridge;
from Los Angeles' Metropolitan Water District to New York's Manhattan Tunnels;
from Minneapolis' Interceptor Sewers to New Orleans' Huey Long Bridge;
from Chicago's Outer Drives to Atpeco, Texas, Oil Refineries;
from Boulder Dam to Brakhamstead Dam;
they found that it paid to forget the old stuff in favor of the Rex Pumpcrete.
In 1937, before you buy, before you bid, investigate the up-to-date methods of pumping concrete.

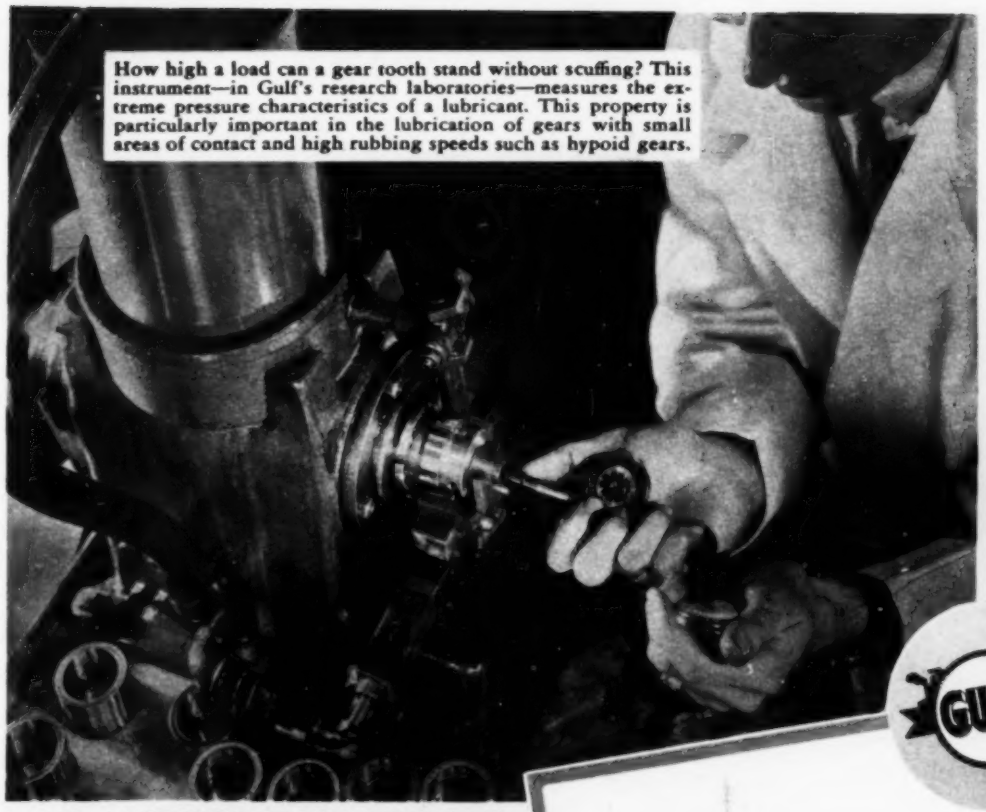
**Chain Belt Company, 1664 W. Bruce St., Milwaukee, Wis.**

REX

## REX UP-TO-DATE METHODS OF HANDLING CONCRETE

## CONCRETE BY PIPE LINE—WITH THE REX PUMPCRETE

## CHAIN BELT COMPANY OF MILWAUKEE



How high a load can a gear tooth stand without scuffing? This instrument—in Gulf's research laboratories—measures the extreme pressure characteristics of a lubricant. This property is particularly important in the lubrication of gears with small areas of contact and high rubbing speeds such as hypoid gears.

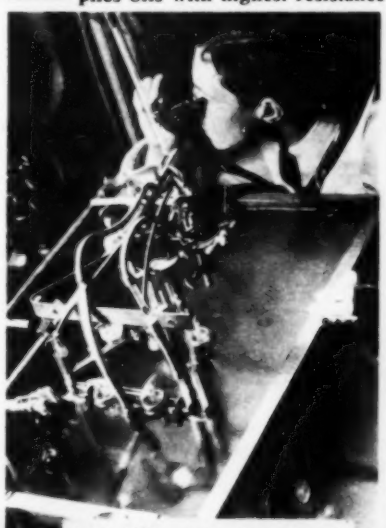
Many new bearing metals have been developed during recent years. Here the Underwood test is used to determine the effects of oils on various bearing metals.

GULF INDUSTRIAL LUBRICATION

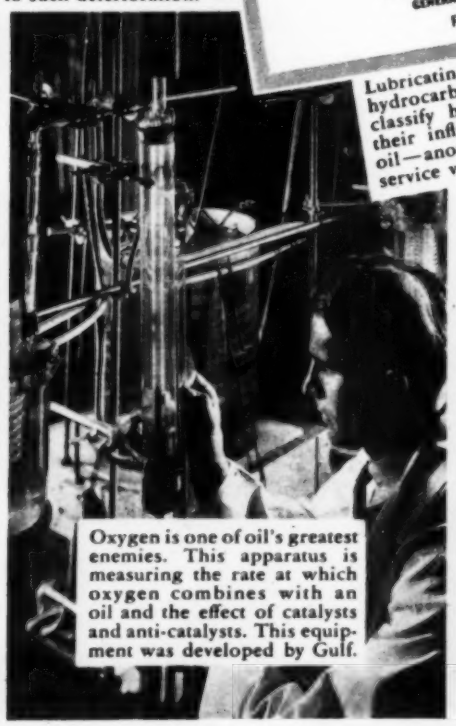
# *Know* WHAT'S BEHIND QUALITY CLAIMS WHEN YOU BUY LUBRICANTS ...*Industrial or Automotive*

GULF OIL CORPORATION
GULF REFINING COMPANY
GENERAL OFFICES: GULF BUILDING
PITTSBURGH, PA.

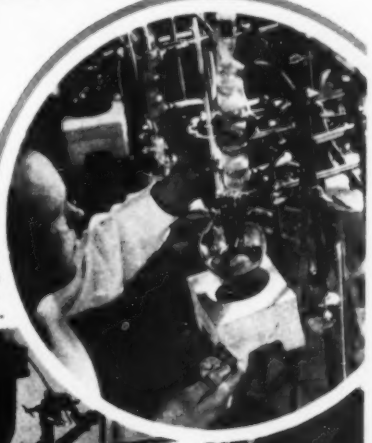
This complicated apparatus—in Gulf's laboratories—is used to study the behavior of oils at high temperatures in the presence of oxygen. Some oils deteriorate more rapidly than others under these conditions, forming organic acids, insoluble sludges, and soluble impurities of high viscosity. Samples of the oil are withdrawn at frequent intervals for test, and changes measured. Gulf supplies oils with highest resistance to such deterioration.



The "Chemist's Aquarium." This adiabatic thermostat measures extremely small temperature changes due to chemical reaction in an oil. The data secured are valuable in certain fundamental studies.



Oxygen is one of oil's greatest enemies. This apparatus is measuring the rate at which oxygen combines with an oil and the effect of catalysts and anti-catalysts. This equipment was developed by Gulf.



Lubricating oils contain many types of hydrocarbon molecules. Gulf scientists classify hydrocarbons with respect to their influence on the stability of the oil—another step to insure the high service value of Gulf quality lubricants.

A new machine developed by Gulf engineers—the first that will test any bearing under precisely the operating conditions of actual service. It measures accurately friction, torque, temperature, wear and film thickness. Thus, Gulf research engineers develop new information which is useful in the manufacture of improved bearing lubricants.

GMC

THE TRUCK OF VALUE

**Announcing for 1937** . . . A new and complete line of GMC trucks . . . Advanced stream-styling that sets a new standard . . . New Cab-Over-Engine models ranging in capacity up to 12 tons and including the lowest priced 1½ ton of this type now offered . . . New ½-tons in both 126-inch and 112-inch wheelbases, the latter priced at only $395, chassis f. o. b. Pontiac . . . Improvements and refinements throughout the entire line . . . In every capacity range an exceptional value.

**$395 AND UP**
CHASSIS F. O. B. PONTIAC

*Time payments through our own Y. M. A. C. Plan at lowest available rates*

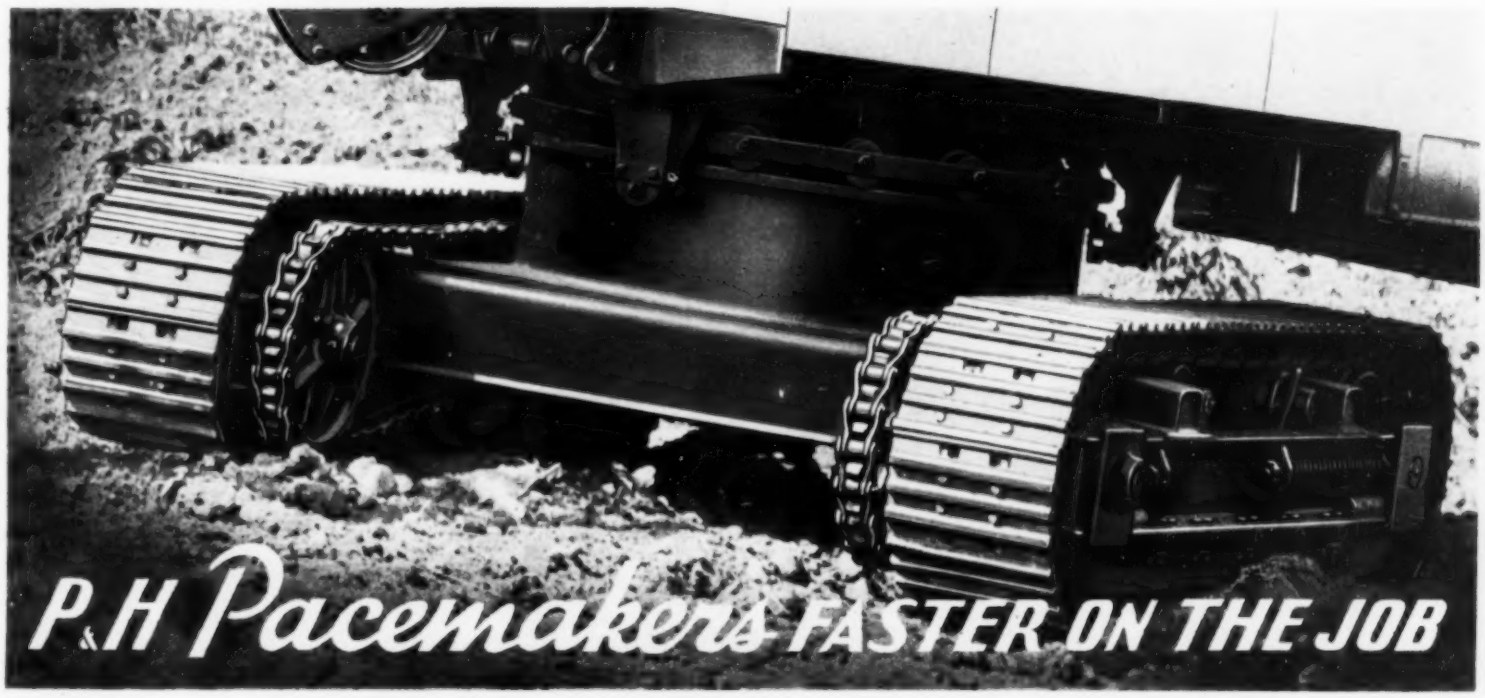
**GENERAL MOTORS TRUCKS & TRAILERS**

GENERAL MOTORS TRUCK & COACH
DIVISION OF
YELLOW TRUCK & COACH MANUFACTURING COMPANY, PONTIAC, MICHIGAN

*"The whole industry will have to come to all welded construction to keep up with these P&H Pacemakers." — Frank Pakiz, shovel operator.*

# *There's Millions*

## OF PROVED TRAVEL MILES BEHIND THESE TRACTOR TYPE CRAWLERS




The P&H Pacemakers are the first and only machines equipped with these tractor type crawlers. Here's an assembly that's *built* for travel—*hard travel*—not mere browsing. Hinge action shoes of tough heat-treated alloy steels take it over the ground with true rolling movement—with freedom from breakdowns wherever you go. This type of crawler has proved itself in literally millions of miles of tractor service . . . it's only one of the many important advancements that make these P&H Pacemakers faster on the job.

**HARNISCHFEGER CORPORATION**

4494 W. National Ave. *Established 1884* Milwaukee, Wis.

*Warehouses and Service Stations:*

Hoboken — Memphis — Jacksonville — Dallas — Seattle — Los Angeles — San Francisco

**HARNISCHFEGER CORPORATION**

EXCAVATORS • ELECTRIC CRANES P&H SERVICE HOISTS • MOTORS • ARC WELDERS

# *Judge the value of a Truck Mixer by its ability to produce*

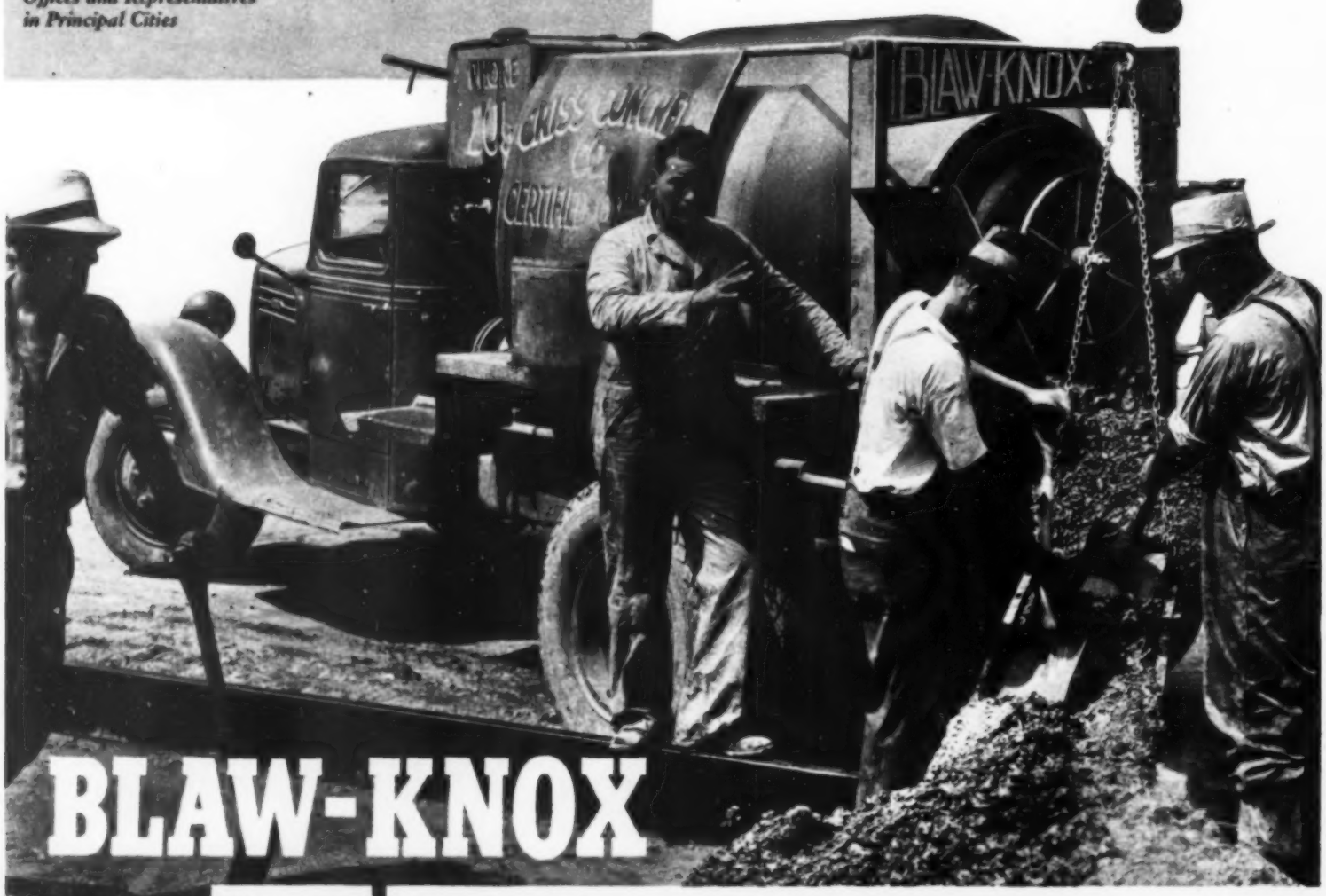
# *Quality Concrete!*

- **Only a dependable truck mixer can make money for you.**
- **Dependable—in that it can be relied upon to consistently produce and deliver concrete of high, uniform quality for any mix that may be specified or desired.**
- **Investigate Blaw-Knox TRUKMIXERS for your future profits.**

**BLAW-KNOX COMPANY**

**2086 Farmer's Bank Building · Pittsburgh, Pa.**

*Offices and Representatives in Principal Cities*



# KOEHRING

New 503

Koehring offers another new model for 1937 — The 503 with selective swing speeds, anti-friction bearings, enclosed gears — a fast machine with abundant power for all types of work. Shovel has the Koehring Chain Crowd, all-welded boom and the exclusive boom foot shock absorber. Write for bulletin today!

See us at the Road Show in New Orleans. Ask us for complete information about Koehring Construction Equipment . . . Booths Nos. B9, B10, B27, B28.

KOEHRING COMPANY

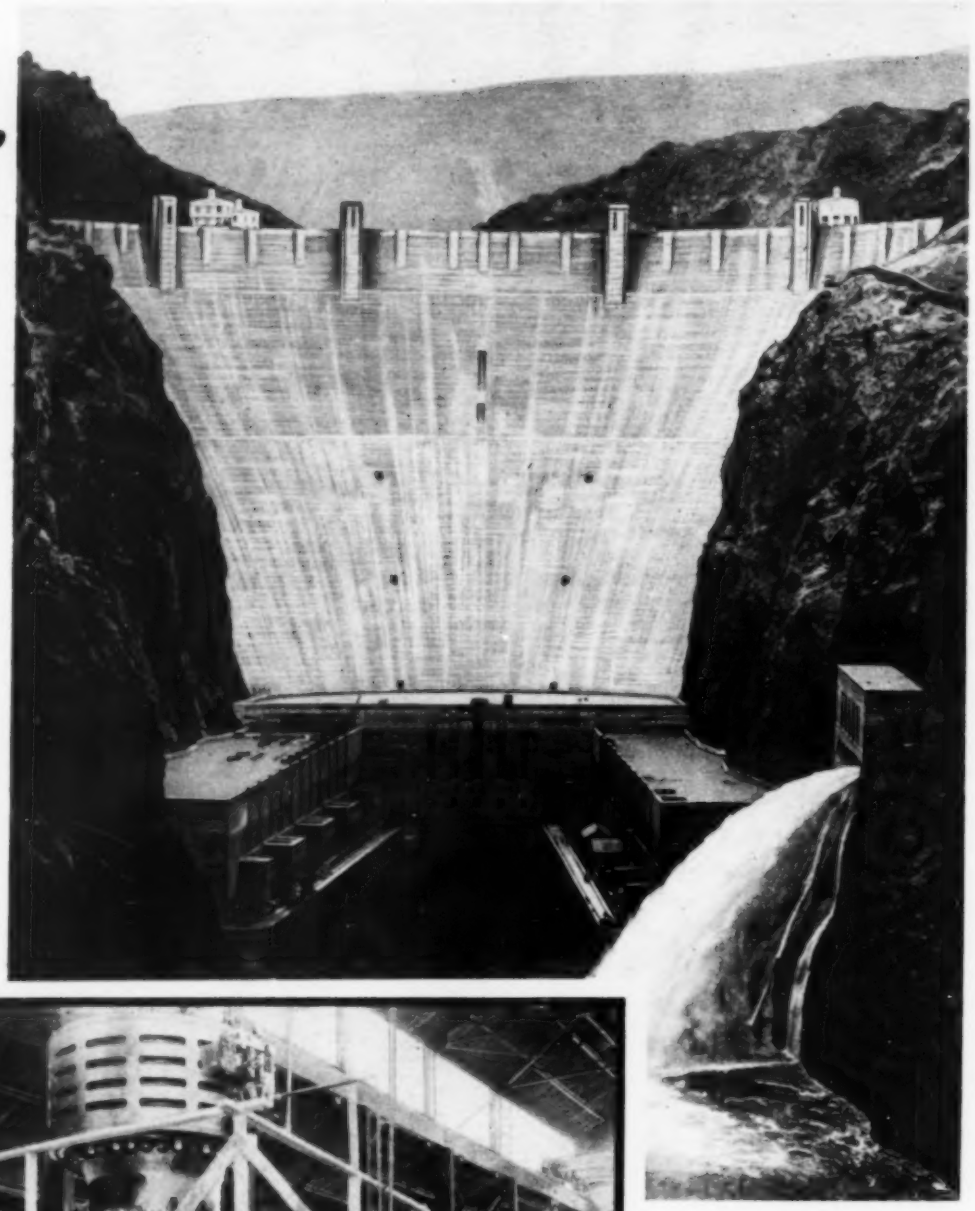
Pavers · Mixers · Shovels · Cranes · Draglines · Dumptors · Mud-Jacks

3026 WEST CONCORDIA AVENUE, MILWAUKEE, WISCONSIN

# 400,000 POUNDS

## —AND THEY CALL IT A "Butterfly"

***That's the scale they do things on at Boulder Dam***



OF COURSE, it's not just *size* that counts, when you're deciding what metal to use to carry out the design for a job like the butterfly valves at Boulder Dam. Every ounce of metal used had to have the stamina to withstand the onset of tons of water for a generation or longer.

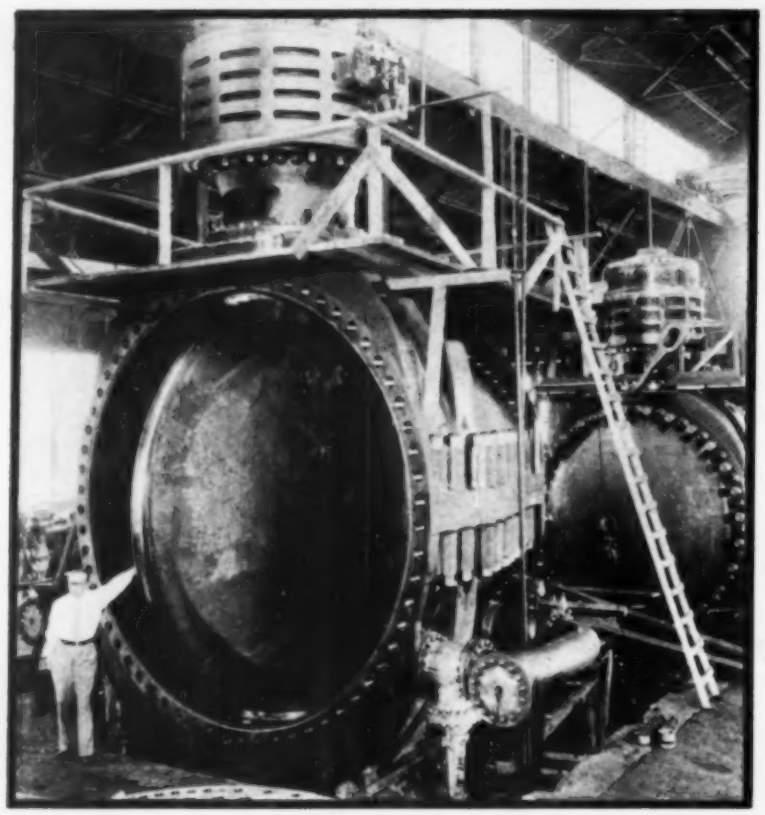
But size does matter—in more ways than one. It's more difficult to keep uniformity of grain texture, to hold the vital toughness, when your castings are 168 inches diameter, like this one. And think of the enormous cost of repairs and replacements . . . the engineers had to choose metals that would need none for years.

To assure these results, six 168-inch valves like this one were specified of a Nickel Alloy Steel, cast to this composition:

| | |
|---|---|
| Carbon | 0.25—0.35% |
| Manganese | 1.00% max. |
| Silicon | 0.40% |
| Nickel | 1.00—1.50% |

With this analysis, the valves show a minimum tensile strength of 75,000 p.s.i., and a yield point of 50,000 p.s.i.

Main holding bolts require somewhat different properties, which Boulder Dam's engineers supplied with S.A.E. 2340, a 3½% Nickel Steel. Let the Inco engineers apply their wide experience to help you find the best type of Nickel Alloy Steel to fit your particular needs.



● One of six 168-inch butterfly valves for Boulder Dam, weight 400,000 pounds. These were made by Hardie-Tynes Mfg. Co., with Nickel Steel Castings containing 1 to 1.50% Nickel supplied by the Erie Forge Co.

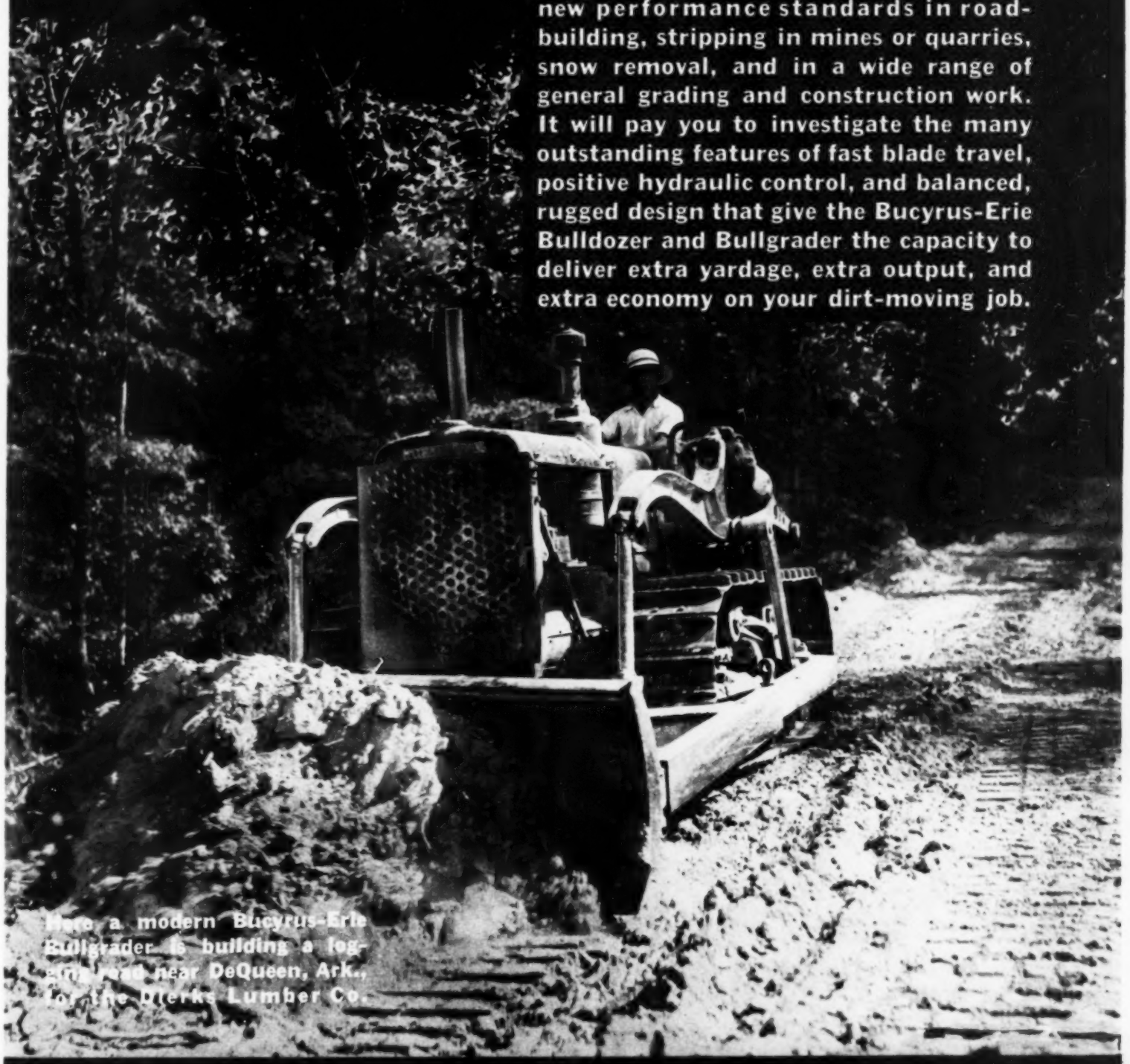
## NICKEL ALLOY STEEL

**THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.**

# BUCYRUS-ERIE

## *Dirt Moving Economy*

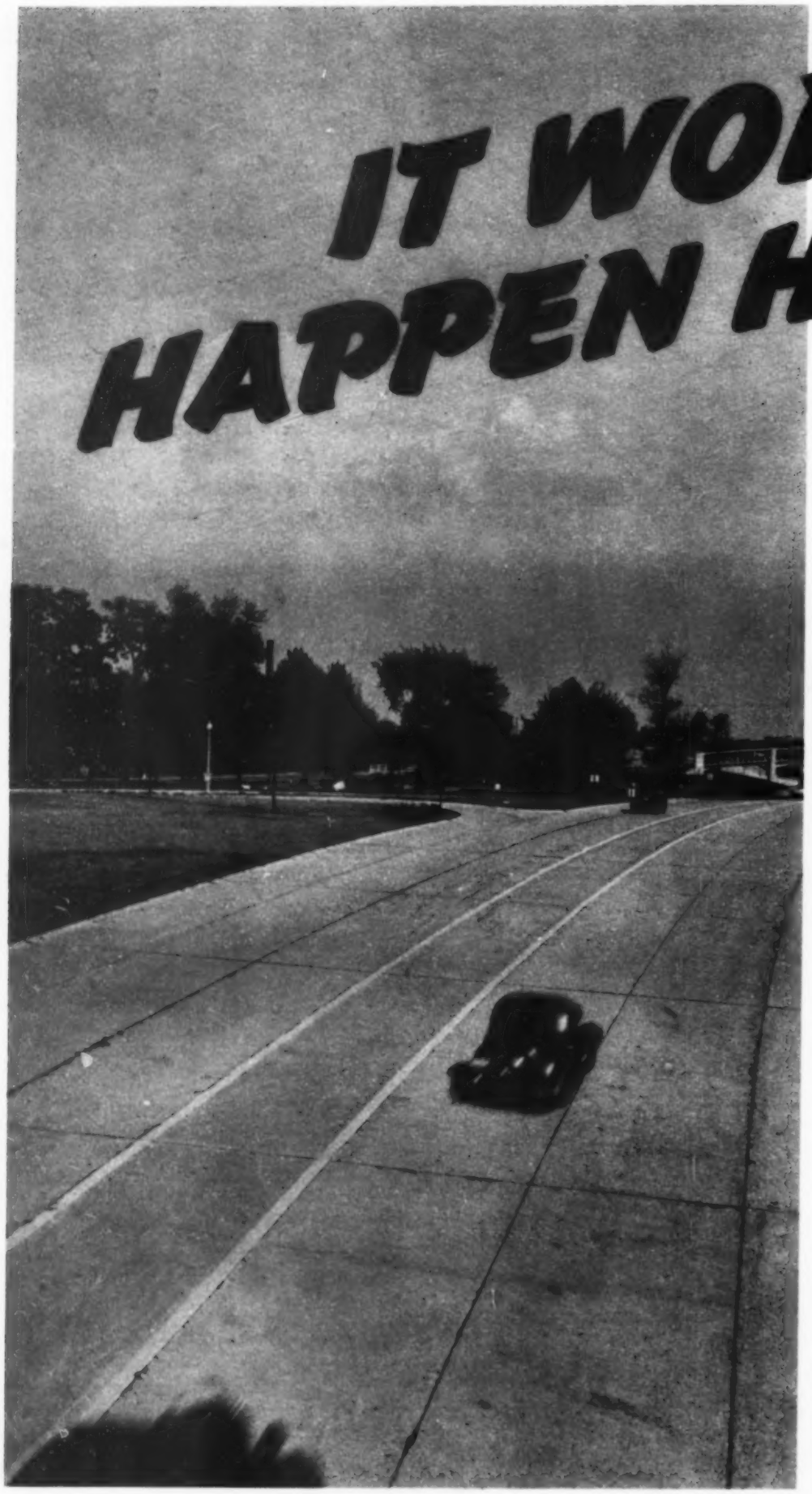
with a Bucyrus-Erie Bulldozer or Bullgrader is the result of faster blade action, bigger pay loads, and a new, wider range of operation on every job. These modern units are already setting new performance standards in road-building, stripping in mines or quarries, snow removal, and in a wide range of general grading and construction work. It will pay you to investigate the many outstanding features of fast blade travel, positive hydraulic control, and balanced, rugged design that give the Bucyrus-Erie Bulldozer and Bullgrader the capacity to deliver extra yardage, extra output, and extra economy on your dirt-moving job.



Here a modern Bucyrus-Erie Bullgrader is building a log-ging road near DeQueen, Ark., for the Pierce Lumber Co.

BUCYRUS ERIE

EXCAVATING, DRILLING, AND MATERIAL HANDLING EQUIPMENT... SOUTH MILWAUKEE, WISCONSIN, U.S.A.



# IT WON'T HAPPEN HERE!

One million people seriously injured in *one year* through traffic accidents. That's what the 1936 record will show.

"It's got to stop!" people shout indignantly . . . and go right on cracking bones and fenders.

So—the only thing highway officials *can* do is to make streets and highways as safe as possible. They find that Atlas White Markers, shown in the picture at the left, help tremendously. For these easy-to-see markers act as safety guides. They keep drivers in their own lanes, out of the other fellow's territory.

Atlas White Markers are strips of hard, durable concrete built right into the street or road. They *stay* in and they *stay* white. Rain can't wash them away. Heaviest traffic can't wear them away.

**No maintenance or repair expense**

Do not confuse Atlas White Markers with the painted-on kind. Atlas White Markers are a permanent part of the pavement itself. Their life is for the life of the pavement. Once installed, you never have to give them another thought. There's no maintenance. No repair expense. No replacement expense.

That's why highway and safety officials find that Atlas White Markers, although higher in first cost, save money over temporary methods in the long run.

*Help build Safety into Streets and Highways with Atlas White Traffic Markers — Made with Atlas White Portland Cement—Plain and Waterproofed.*

**UNIVERSAL ATLAS CEMENT CO.**
**208 South La Salle Street, Chicago**

*United States Steel* *Corporation Subsidiary*

M9

*Safety Markers of Atlas White Portland Cement on Super-Highway through Forest Park, St. Louis, Mo. Constructed by Webb-Boone Paving Company, St. Louis, under plans and specifications prepared by Missouri State Highway Commission.*

ATLAS WHITE PORTLAND CEMENT FOR TRAFFIC MARKERS

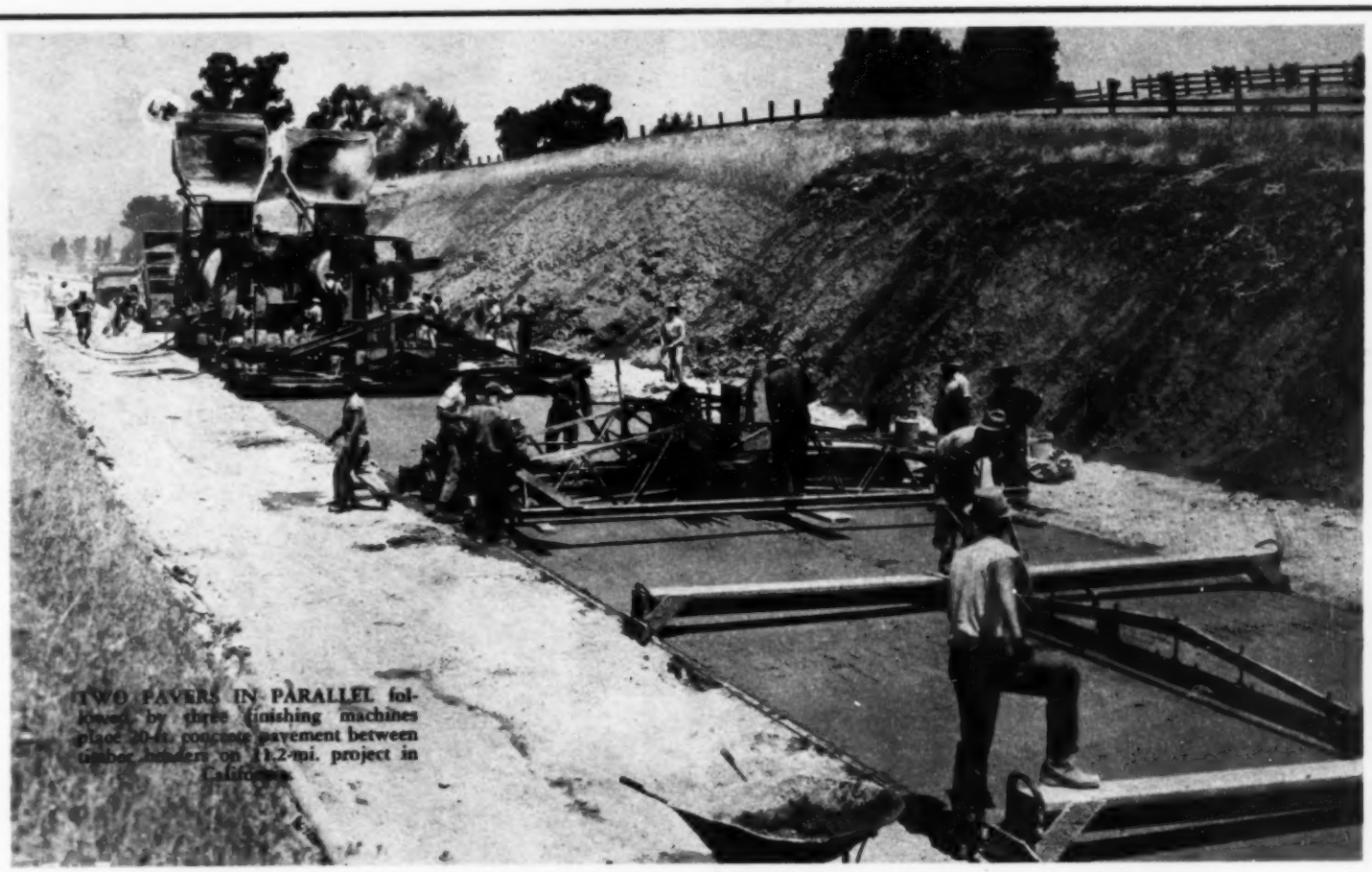
Established 1919
McGraw-Hill Publishing Company, Inc.

# Construction
Methods and Equipment

ROBERT K. TOMLIN,
Editor

Volume 19 Number 1

**January, 1937**



**TWO PAVERS IN PARALLEL** followed by three finishing machines place 20-ft. concrete pavement between timber headers on 11.2-mi. project in California.

Photos from California Division of Highways

# Twin Mixers Pave Cutoff

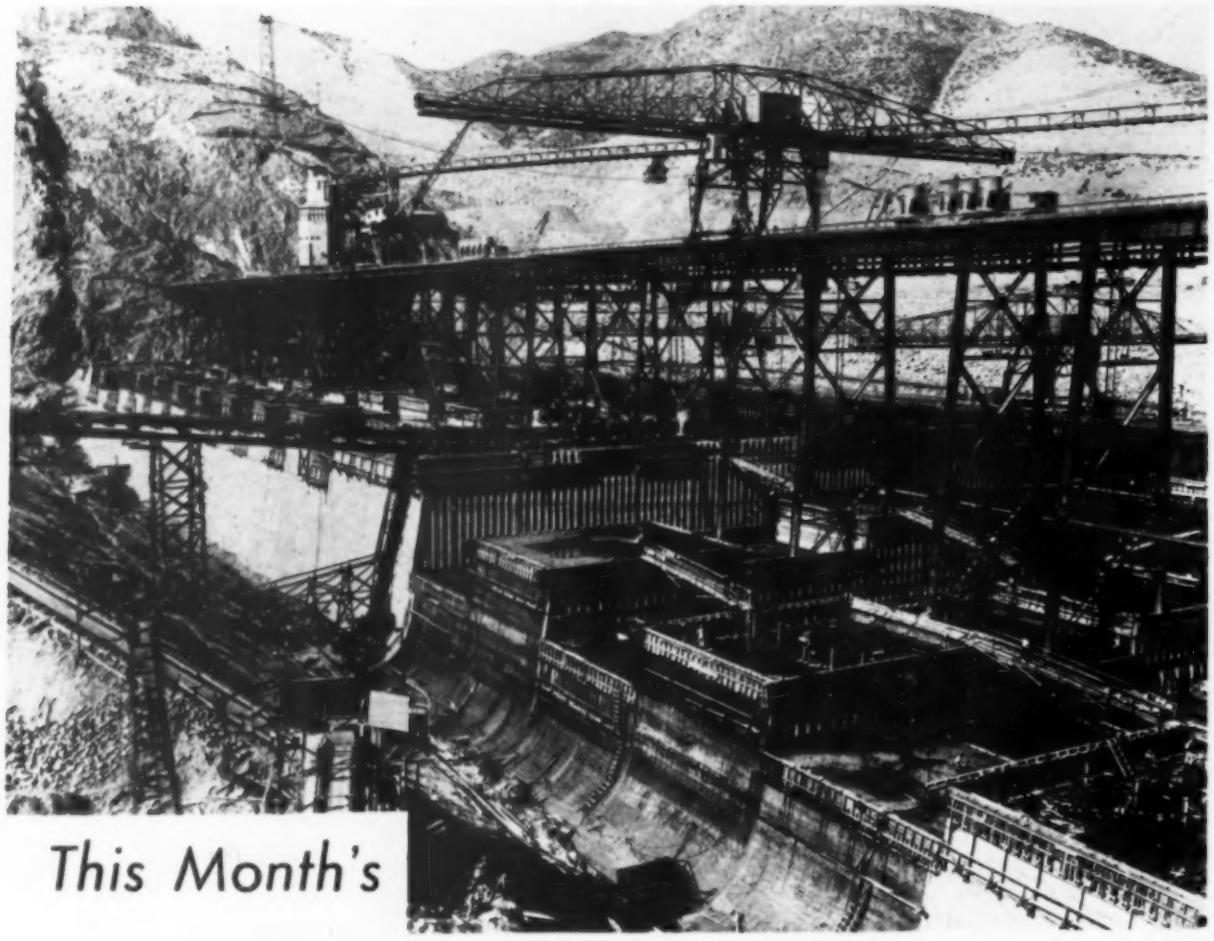
TWO 1-YD PAVING MIXERS traveling side by side on a subgrade of specially selected material laid 11.2 mi. of 20-ft. concrete slab on the American Canyon highway realignment in California, designed to eliminate five railroad grade crossings and save 6 mi. in distance between San Francisco and Sacramento. In constructing an additional 10-ft. lane adjacent to the 20-ft. slab for 1.4 mi. at one end of the project, the two pavers operated in tandem. Three finishing machines behind the mixers carried out the mechanical finishing operation in successive steps.

Difficult grading involving excavation of 1,475,000 cu.yd. from cuts up to 130 ft. deep and building of fills up to 80 ft. high preceded by more than a year the award of a contract for placing selected subgrade material and paving. Prior to placing of the subgrade fill, the existing grade was sealed with ⅜ gal. per square yard of asphalt put on in two applications.

Edge forms for the pavement consisted of timber headers backed up by earth berms. Between the mixers and the point of bucket discharge a steel crew placed longitudinal and transverse reinforcement. The first finishing machine, a double-screed unit, carried two gasoline-powered vibrators which were used continuously to vibrate concrete ahead of the first screed. Behind this finisher, another machine performed the second finishing operation. As the third step, a single-screed finisher carried a small wave of grout for the final finishing operation.

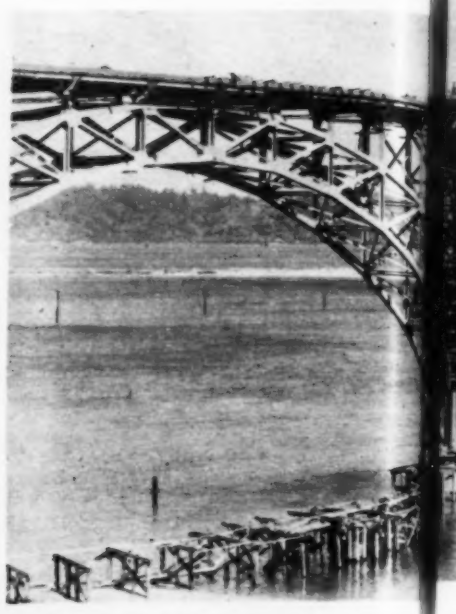
Following the last finisher, a grooving machine cut a 2-in. slot along the longitudinal center line, into which the operator placed 10-ft. lengths of steel rod to a depth of about 2 in. Behind this machine two men using heavy slotting tools made transverse grooves into which ¼x2-in. steel strips were inserted at weakened-plane transverse joints between expansion joints. Hand finishers removed the steel from the center-line and transverse weakened-plane joints.

**SACKED CEMENT** from line distributed in advance along shoulder is added to batch of truck-dumped aggregates in mixer skip. Subgrade is built up with selected fill 1 to 1½ ft. deep.



This Month's

# "NEWS REEL"



**MILLION YARD MARK**

**has been passed in placing concrete in Grand Coulee dam *(left)*, key structure in plan for development of Columbia River in Washington. Four traveling cranes of double cantilever type, operating on steel trestles 80 and 160 ft. high, handle 4-cu.yd. buckets delivering mix into forms for body of structure, being built for U.S. Bureau of Reclamation by Mason-Walsh-Atkinson-Kier Co. Dam will raise water of Columbia River 355 ft. Ultimate volume of concrete will be 11,000,000 cu.yd. for dam 550 ft. high above bedrock, 4,300 ft. long and 500 ft. thick at base. Present contracts call for completion of foundation of dam and power house to elevation 50 ft. above low water.**

**HIGHWAY SAFETY**

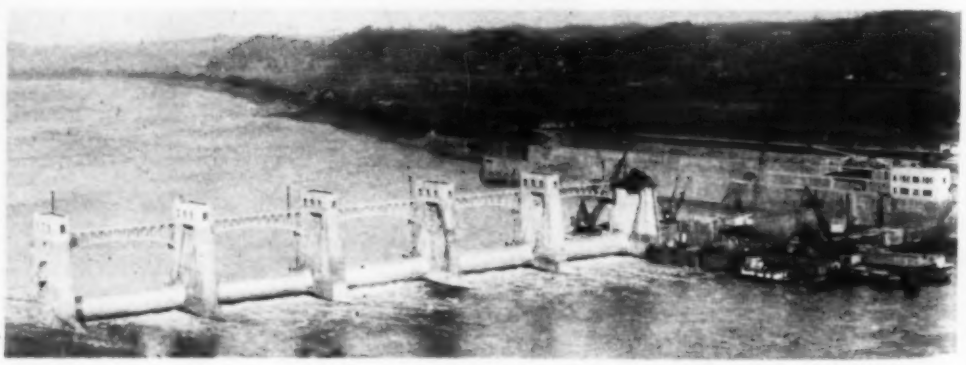
**is recognized in presentation of plaque *(below)* to Edward N. Hines, *(right)*, member of Board of Wayne County (Michigan) Commissioners, as originator of center traffic line now in universal use. Presentation was made by J. D. Tew, president of B.F. Goodrich Co., at annual convention of American Automobile Association, Detroit, Nov. 20.**

**NEW YORK WORLD'S FAIR SITE**

**on Flushing Meadow, Long Island, where grading operations now underway involve handling of 40,000 cu.yd. of earth daily, is inspected by group including *(left to right)* Irvin Scott, chief architect, and Col. John P. Hogan, chief engineer, for World's Fair; Jacques Greber, architect for Paris Exposition of 1937; Grover A. Whalen, president of World's Fair; Francois de Tessan, Under-Secretary of State for France; and W. Earle Andrews, general manager of World's Fair. Scheduled date for opening Fair is April 30, 1939.**

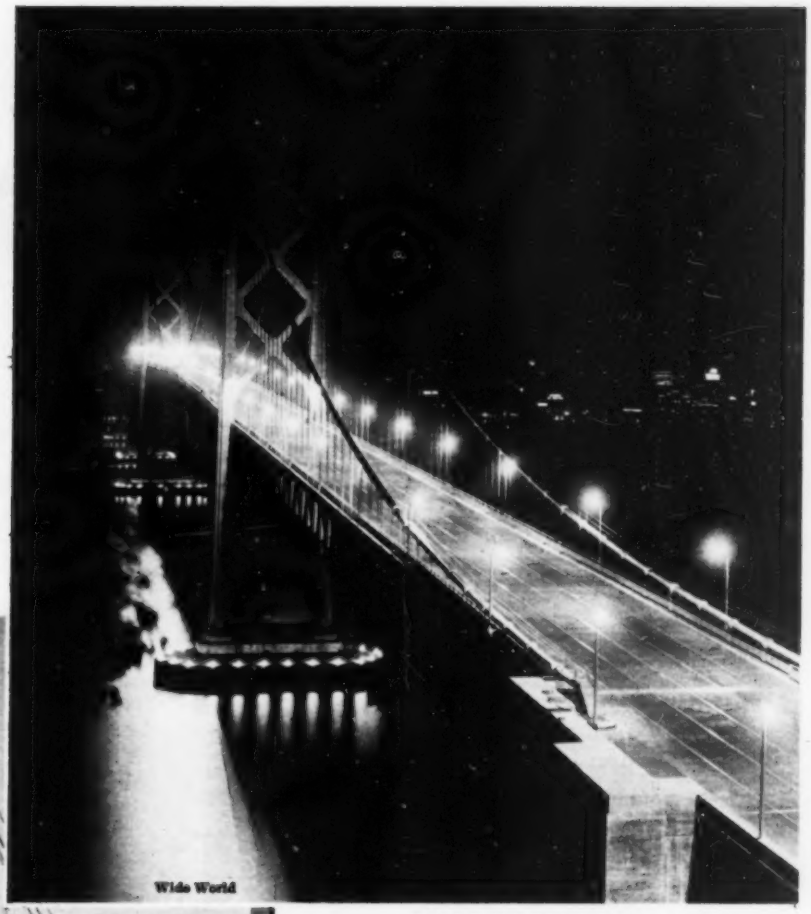
**GALLIPOLIS DAM**

***(right)* advances in three stages across Ohio River from Ohio shore to connection with completed pair of locks at Hogsett, W. Va. Each section is inclosed during construction by cellular steel sheetpile cofferdam. With completion of cofferdam for third section adjacent to locks, roller gates were lowered and dam was put into service Oct. 29, replacing six movable dams upstream, three in Ohio River and three in Kanawha River. Dravo Contracting Co., Pittsburgh, built structure under direction of U. S. Engineer Office, Huntington, W.Va.**



## YAQUINA BAY BRIDGE

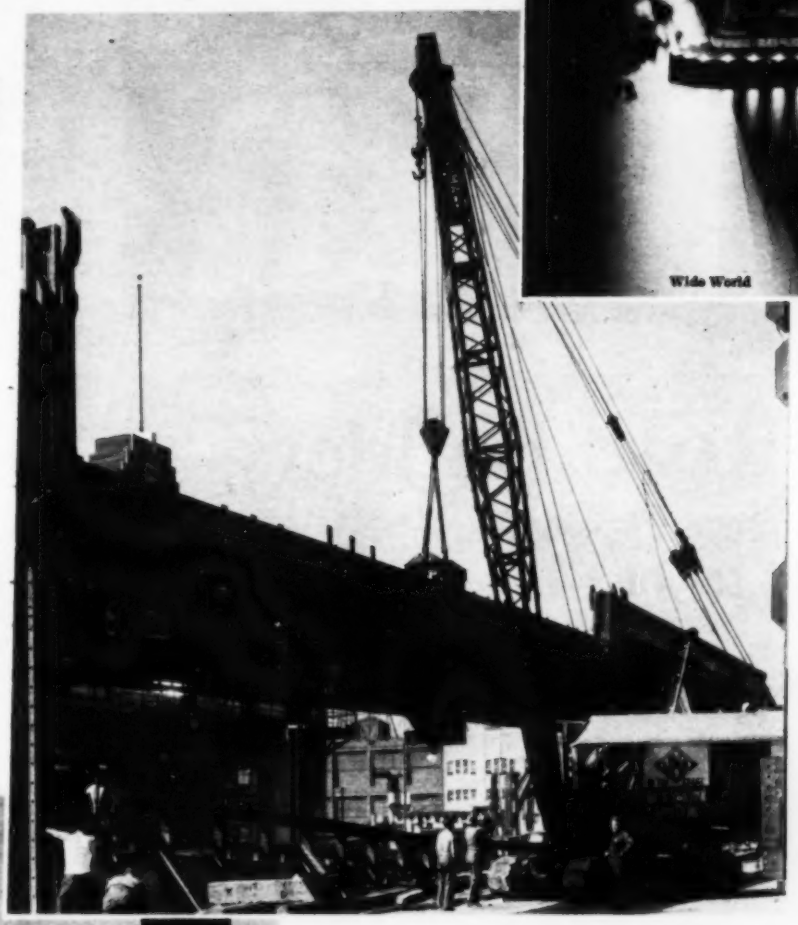
is last of five structures recently completed on Coast or Redwood Highway in Oregon, with PWA loan and grant of $5,600,000. Yaquina Bay bridge, near Newport, has total length of 3,260 ft., including 600-ft. steel arch with under-clearance of 135 ft. to accommodate coastwise navigation. Main channel span is flanked on both sides by 300-ft. steel arch deck spans, while approaches are reinforced concrete arches and viaduct.



Wide World

## SODIUM VAPOR LIGHTS

of new design *(above)* illuminate six-lane concrete roadway of newly completed San Francisco-Oakland Bay Bridge in California, officially opened to traffic Nov. 12. Nighttime view shows cable suspension spans and towers of West Bay crossing between San Francisco and Yerba Buena island.



## ELEVATED EXPRESS HIGHWAY

along Hudson River, New York City, nears completion as 60-ton steel girder *(right)* is raised to place by Lima locomotive crane with 50-ft. boom, in service of Harris Structural Steel Co., Inc., subcontractor for James Stewart & Co., Inc., general contractor.

## BY AIR TO ROAD SHOW

Charles M. Upham *(below, right)* engineer director of American Road Builders' Association, journeys by airplane from Washington, D.C. to New Orleans, scene of forthcoming annual convention and Road Show, January 11-18, 1937. Accompanying Mr. Upham is L. W. Kern, member of Maryland State Road Commission.

## TOPPING OUT

of steelwork for new 36-story building at Rockefeller Center, New York City, *(left)* is completed Nov. 27 by Post & McCord, subcontractors for steel erection under Barr, Irons & Lane, general contractors. Rising to height of 490 ft., structural frame carrying 9,000 tons of steel was completed in 43 working days, steel placement averaging 208.3 tons daily. New building, between 48th and 49th Sts., is eleventh to be erected in Rockefeller Center group.

TYPICAL GRADING SECTION on Blue Ridge Parkway involves cuts in earth and rock. Practically all material is loaded by power shovels for removal to fills at average hauling distances of about 1,000 ft.

# Mountain Road Builders

## Grade 140 Miles of Route for

# Blue Ridge Parkway

CONSTRUCTION of 140 mi. of scenic mountain road on sixteen contract sections of the projected Blue Ridge Parkway, 500 mi. in length, connecting Shenandoah National Park in Virginia with Great Smoky Mountains National Park in North Carolina, called into action during 1936 more than a score of modern earth-moving outfits equipped to handle earth and rock under the difficult conditions encountered in rough country. Digging and transporting all classes of rock and earth on grading sections involving average excavation quantities of 20,000 to 85,000 cu.yd. per mile, these outfits moved on each section an average of 50,000 cu.yd. or more per month during the working season. Since last spring the grading outfits have moved 4,100,000 cu.yd.

A surprising amount of new equipment of the most modern type is employed in these extensive road grading operations. Because of the isolated location of most of the grading sections, dependability of the equipment is of paramount importance. Remote location of the work likewise compels the contractors to open local quarries to produce the crushed rock with which the roadway is surfaced.

*Blue Ridge Parkway*—Sponsored by Secretary Ickes of the Interior Department, a 500-mi. mountain parkway intended solely for recreational travel between the great national parks in Virginia and North Carolina received an initial allotment of $6,000,000 from PWA about two years ago. Location, design and construction of the parkway were assigned to the engineers of the Bureau of Public Roads, working in close collaboration with landscape architects of the National Park Service, under a long-standing agreement between the Interior Department and the Department of Agriculture by which the bureau serves as agency for all major road construction in the national parks. In accordance with this arrangement, all roadway construction in progress on the parkway is directed by engineers of the Bureau of Public Roads, while control of all landscape features remains in the hands of the National Park Service.

*Design Standards*—Grade and alignment of the roadway conform to established standards of the Bureau of Public Roads. Grades ordinarily are held to 6½ or 7 per cent, but a maximum of 8 per cent is permitted for sections of 1,000 to 1,500 ft. Curves on the outside of a mountain (sight distance obstructed) are limited to a minimum radius of 200 ft.; inside curves (sight distance unobstructed) have a 150-ft. minimum radius requirement. All curves are spiraled, and curves sharper than 30 min. are superelevated. The longitudinal profile of the route emphasizes long vertical curves. The roadway consists of a 20-ft. crushed stone surface on a 30-ft. grade, both in cuts and on fills. Under the present contracts, crushed stone surfacing is being placed loose to a depth of 6 in. for later compaction by traffic. All the crushed rock passes a 1-in. screen, and 25 to 35 per cent passes a ¼-in. screen.

*Special Requirements*—Preservation of landscape features, so essential to the beauty and recreational character of the parkway, imposes certain restrictions in location and construction. Location is fixed to avoid destruction of timber and scenic values along the route. Construction requirements are written with the object of preserving natural beauty by (1) care in blasting and (2) repairing all scars back of the roadway section. Topsoil is conserved by stripping and stockpiling for later placing on slopes.

To hold sidehill fills on steep slopes the design in some places provides stone masonry retaining walls on rock foundation. These walls are constructed of native stone laid up in a rough ashlar pattern requiring skilled workmanship. Construction of the retaining walls takes time and occasionally delays the building of fills. Where retaining walls are not provided, the plans call for toe ditches at the foot of fills placed on natural slopes steeper than 1 on 2.

*Construction Conditions*—Average elevation of the Blue Ridge Parkway for its entire length of 500 mi. is 2,500 ft. above sea level. Construction operations on the sixteen grading sections in progress during 1936 were carried on at elevations ranging from

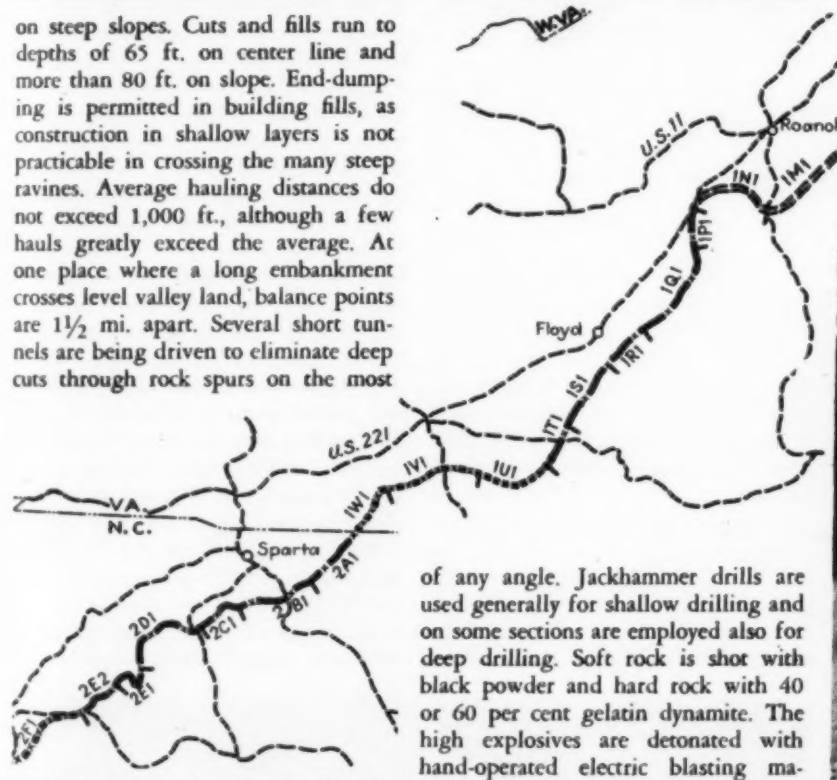
2,000 to 4,000 ft. above sea level. As indicated by the accompanying map, construction is in progress at separated locations in Virginia and North Carolina.

All excavation is unclassified. The proportion of rock requiring blasting ranges from 15 to 60 per cent on the various sections, and the rock itself includes all gradations from soft shales to hard mica schist. Nearly every project exhibits a wide variety in hardness and stratification of rock, presenting blasting problems which require frequent changes of method.

For two reasons the parkway offers little opportunity for sidecasting. Good alignment does not permit following contours, and good appearance makes it necessary to avoid the deep scars produced by cutting and sidecasting on steep slopes. Cuts and fills run to depths of 65 ft. on center line and more than 80 ft. on slope. End-dumping is permitted in building fills, as construction in shallow layers is not practicable in crossing the many steep ravines. Average hauling distances do not exceed 1,000 ft., although a few hauls greatly exceed the average. At one place where a long embankment crosses level valley land, balance points are 1½ mi. apart. Several short tunnels are being driven to eliminate deep cuts through rock spurs on the most southerly group of contract sections in North Carolina.

**Mileage Status, Blue Ridge Project, Oct. 1, 1936**

| Status | Blue Ridge Parkway | | | Shenandoah Nat. Park | Totals, Park and Parkway |
|---|---|---|---|---|---|
| | N. C. | Va. | Total | Va. | |
| Completed | | | | 64.8 | 64.8 |
| Under Construction | 77.6 | 55.8 | 133.4 | 17.1 | 150.5 |
| Plans completed | 37.9 | 30.1 | 68.0 | 4.5 | 72.5 |
| Surveys completed | 46.9 | 45.8 | 92.7 | 10.0 | 102.7 |




500-MI. PARKWAY extending from north end of Shenandoah National Park to North Carolina entrance of Great Smoky Mountains National Park has large mileage of road completed, under construction or surveyed, as indicated by route map and by table at left.

More than half the mileage under construction in 1936 penetrated rugged terrain requiring the opening of a pioneer road before any kind of hauling equipment could operate. Much of this territory is covered with heavy timber or thick second growth which has to be removed by a clearing and grubbing crew in advance of the pioneer shovel. Pioneering work requires weeks of shovel time on each contract section. To avoid marring the landscape, the pioneer roads ordinarily are built inside the roadway section. Sidecasting usually is possible in opening the narrow pioneer roads, but in country cut by deep ravines hauling units have to operate in conjunction with the shovels to make the first lifts of fills.

*Grading Equipment* — Shovels of 1½- to 2½-yd. capacity do the digging on all sections. Power plants in these units are diesel, semi-diesel or gasoline, with a great preponderance of diesel engines in the new excavators. A good portion of topsoil stripping and of excavating in earth and shale is done with large tractor-drawn scrapers of 7- to 12-yd. size which carry the material to the point of deposit on hauls up to 800 ft. New tractors are predominantly diesel or diesel-fuel units. For the deeper drilling most of the contractors prefer wagon drills designed to operate in vertical position without the use of staging on slopes of any angle. Jackhammer drills are used generally for shallow drilling and on some sections are employed also for deep drilling. Soft rock is shot with black powder and hard rock with 40 or 60 per cent gelatin dynamite. The high explosives are detonated with hand-operated electric blasting machines in shots up to 200 holes, breaking as much as 3,000 cu.yd. of hard rock.

For average hauls of 500 to 1,000 ft. and for handling all classes of earth and rock excavation most of the contractors use tractor-drawn two-way-dump track wagons of 8- to 11-yd. capacity. At these hauling distances, two to four units of this type take the output of a shovel. On some sections pneumatic-tired or track-mounted trucks or tractor-trucks build fills by end-dumping. Many of the tractor-trucks are geared to save turning time by running loaded in reverse to the dumping point. For hauls of several thousand feet, the contractors put on pneumatic-tired trucks whenever units of this type are available.

A power shovel served by adequate hauling equipment and working two shifts a day loads about 50,000 cu.yd. per month. Tractor-drawn scrapers have made some exceptionally good records. One 12-yd. unit drawn by a 95-hp. diesel tractor working 24 hr. a day in one month moved almost 60,000 cu.yd. of earth and shale.

A more detailed understanding of conditions encountered and methods employed in road building on the Blue

IN ADVANCE OF FILL being built on Section 2E2 by bulldozer and heavy trucks hauling from 2½-yd. diesel shovel in background, culvert crew lays 24-in. concrete pipe on steep slope. Contractors have option of laying concrete or cast-iron pipe, and corrugated cast iron is installed on some sections.

## Blue Ridge Federal Road Contracts in Progress During 1936

| Section | Contractor | Length Mi. | Unclassified for Roadway Quantity, Cu. yd. | Excavation Grade Only Unit price Cu. yd. | Total Contract Price | Date of Award | Contract Completion Date | Per Cent Complete Nov. 1, 1936 |
|---|---|---|---|---|---|---|---|---|
| 3A1 | M. E. Gillioz, Inc. Monett Mo. | 7.309 | 500,000 | $0.55 | $438,475 | 12-27-1935 | 4-11-1937 | 59 |
| 3B1 | M. E. Gillioz, Inc. Monett Mo. | 9.821 | 474,000 | 0.50 | $461,387.50 | 3-27-1936 | 6-24-1937 | 27 |
| 1A1 | Ralph E. Mills Co. Frankfort Ky. | 8.496 | 335,500 | 0.54 | $322,865 | 12-14-1935 | 3-9-1937 | 78 |
| 1P1 | E. W. Grannis, Fayetteville N. C. | 8.277 | 303,000 | 0.30 | $219,912.50 | 12-14-1935 | 3-8-1937 | 88 |
| 1Q1 | T. M. Strider & Co. Nashville Tenn. | 11.027 | 234,000 | 0.28 | $204,375 | 12-14-1935 | 3-15-1937 | 97 |
| 1R1 | W. W. Tuck & Son Virgilina Va. | 9.787 | 248,000 | 0.28 | $215,312.50 | 12-14-1935 | 3-15-1937 | 71 |
| 1S1 | J. Lee & E. A. Vilbig, Inc. Dallas Tex. | 9.003 | 301.000 | 0.34 | $234,675.50 | 12-14-1935 | 3-19-1937 | 59 |
| 1T1 | C. A. Ragland Sr. Louisburg N. C. | 9.222 | 360,000 | 0.28 | $213,566.50 | 12-14-1935 | 3-31-1937 | 62 |
| 2A1 | Nello L. Teer Durham N. C. | 12.49 | 427,000 | 0.29 | $363,837.50 | 8-23-1935 | 10-31-1936 | 83 |
| 2B1 | Albert Bros. Contractors, Inc. Salem Va. | 7.764 | 470,000 | 0.45 | $385,875 | 11-29-1935 | 2-11-1937 | 59 |
| 2C1 | Perry McGlone Kansas City, Mo. | 10.846 | 430,500 | 0.38 | $361,040 | 11-29-1935 | 2-18-1937 | 37 |
| 2D1 | Nello L. Teer & Nello L. Teer, Inc. Durham N. C. | 13.209 | 592,500 | 0.25 | $290,055 | 12-14-1935 | 4-8-1937 | 58 |
| 2E1 | Nello L. Teer & Nello L. Teer, Inc. Durham N. C. | 6.804 | 340,000 | 0.32 | $210,803.75 | 2-1-1936 | 3-15-1937 | 60 |
| 2E2 | C. A. Ragland Sr. Louisburg N. C. | 8.178 | 436,500 | 0.30 | $246,812.50 | 3-7-1936 | 4-18-1937 | 47 |
| 2M2 | Asheville Contracting Co. Asheville N. C. | 3.422 | 292,500 | 0.49 | $366,900 | 4-25-1936 | 9-26-1937 | 19 |
| 2N1 | Kentucky - Virginia Stone Co. Middleboro Ky. | 7.158 | 471,000 | 0.53 | $585,637.50 | 9-24-1936 | 2-6-1938 | 1 |
| 2P2 | M. E. Gillioz, Inc. Monett Mo. (Low bidder) | 7.787 | 555,500 | 0.62 | Low bid $656,597.50 | Bids opened 10-29-1936 | No Award as of 11-16-1936 | |
| Bridges | | | | | | | | |
| 1R2 | Cobb & Homewood Chapel Hill, N. C. | 3 Bridges | | | 27,800 | 8-8-1936 | 3-26-1937 | 47 |
| 1T2 | F. M. Arthur South Boston Va. | 4 Bridges | | | 33,636 | 7-11-1936 | 4-28-1937 | 48 |
| 2A2 | Simons - Mayrant Co. Charleston S. C. | 9 Bridges | | | 156,550 | 3-6-1936 | 1-26-1937 | 78 |
| 2A3 | J. M. Francesa Fayetteville, W. Va. | 1 Steel Viaduct | | | 45,348.40 | 10-23-1936 | 5-30-1937 | |
| 2B2 | J. M. Francesa Fayetteville, W. Va. | 3 Bridges | | | 28,893.75 | 4-17-1936 | 11-8-1936 | 97 |

LARGE GROUP of contractors push more than $5,000,000 worth of road construction on Blue Ridge route. Since table was prepared, Section 2P2 has been awarded to M. E. Gillioz, Inc.

Ridge Parkway can be gained from the following brief descriptions of actual operations on eleven grading sections.

*Section 1 P 1* — A high percentage of rock in cuts up to 57 ft. deep on the high side was uncovered on the north half of this 8¼-mi. section In the first 3 mi. the grading crew struck hard sandstone amounting to about half of the total excavation. Two wagon drills using steel equipped with detachable bits drilled holes to a maximum depth of 25 ft. for blasting with 60 per cent gelatin dynamite. A diesel-powered 340 c.f.m. compressor and a 315 c.f.m. gasoline-driven compressor supplied air to the drills.

Working two 8-hr. shifts, a 1½-yd. diesel shovel loaded 2,500 cu.yd. per day into three 7-yd. track wagons of two-way-dump type drawn by 60-hp. diesel tractors. Spoil was hauled an average distance of 500 ft. and was spread in the fills by a bulldozer on a 45-hp. diesel tractor, A pneumatic-tired 8-yd. scraper stripped and stored topsoil.

*Section 1 Q 1* — A 12-yd. pneumatic-tired scraper drawn by a 95-hp. diesel tractor operating three 8-hr. shifts per day in earth and shale made the exceptional record of moving more than 58,000 cu.yd. in one month on average hauls of 700 to 800 ft. Quartz and flint pockets between shale seams in scraper cuts are broken by plowing with a three-tooth 7,000-lb. rooter. The scraper has demonstrated its ability to maintain a steady average of 100 cu.yd. an hour on downgrade hauls up to 800 ft. long when digging earth and shales that can be plowed. To get large output the scraper always loads downhill and when possible works both ways out of a cut.

Heavy excavation in earth and rock cuts on this 11-mi. section is taken out by a 1½-yd. diesel shovel and hauled to the fills in four two-way-dump track wagons of 7-yd. payload capacity hooked to 60-hp. diesel tractors. A 95-hp. diesel tractor handles a big angle-dozer in spreading fill material and shaping construction roadways.

*Section 1 R 1* — A 7-yd. wheel scraper on pneumatic tires drawn by a 50-hp. diesel tractor moves 100 cu.yd. an hour on this section when digging good material and hauling two ways to fills or stockpiles at an average distance of 300 ft. or less from the loading point. One great advantage of this unit in random excavation is its ability to pick up and dump large boulders.

Rock amounting to 20 or 25 per cent of the total excavation is drilled with a wagon drill and several jackhammers and is blasted with 40 per cent gelatin dynamite. Blasting rock which varies from soft sandstone to hard mica schist, the contractor gets an average of 1 cu.yd. to each pound of explosive. Seamed soft rock causes the greatest difficulty, as it contains pockets of harder rock which remain unbroken after the first blast and require redrilling and shooting. Two gasoline-powered compressors, one 340 and one 220 c.f.m., furnish air for drilling.

A 1½-yd. diesel shovel loads spoil into pneumatic-tired end-dump trucks. The hauling fleet consists of a powerful 7-yd. tractor truck and six 3-yd. roadbuilder trucks. Working two 7-hr. shifts per day the shovel and trucks move 50,000 cu.yd. per month, while the wheel scraper moves 10,000 to 20,000 yd.

*Section 1 S 1* — A 1¾-yd. gasoline shovel is doing both pioneering and

PIONEER WORK in rough country tests durability of 1¾-yd. gasoline shovel on Section 1S1. Excavator digs tough rock without shooting in pushing construction road into new territory.

12-YD. SCRAPER working 24 hr. a day in earth and shale on Section 1Q1 moves almost 60,000 cu.yd. in one month on hauls up to 800 ft. Diesel-powered 95-hp. tractor draws scraper.

STONE MASONRY WALL 200 ft. long and 14 ft. high will retain fill on rock slope of Section 2B1.

2-YD. DIESEL SHOVEL loads one of three pneumatic-tired end-dump hauling units on Section 1T1.

heavy excavating on this 9-mi. section traversing rough, rocky country. The contractor prefers gasoline power for excavators because of long experience with the dependability of the gasoline engine and because of the readiness with which high-grade fuel for the engine can be obtained in any locality. During the first months on the job, largely consumed in pushing a pioneer road into the woods and across the rocky spurs of the mountain side, a fleet of two to six trucks hauled spoil from the shovel. This fleet included three 4-yd. and three 6-yd. trucks. Operating two 7-hr. shifts per day the outfit moved 30,000 yd. in 30 days during which the work was greatly hampered by rain.

During the following month the contractor brought in two new hauling units, 11-yd. heaped-measure two-way-dump track wagons drawn by 60-hp. diesel tractors. These units keep the shovel busy on hauls up to 600 ft. On longer hauls the contractor adds trucks as required. The track wagons make a good hauling road for the trucks. In good digging, the 1¾-yd. shovel loads 200 yd. an hour. The hourly average drops to 150 yd. when loading loose or broken rock.

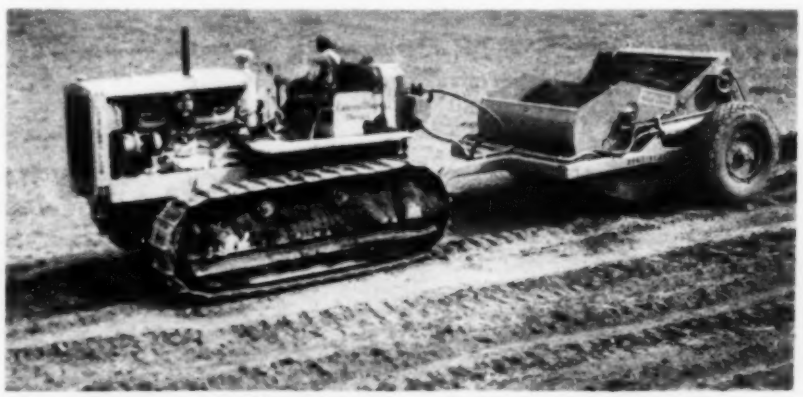
*Section 1 T 1* — Three powerful pneumatic-tired rear-dump trucks of 7-yd. water-level capacity loaded by a 2-yd. diesel shovel move 40,000 to 50,000 cu.yd. per month on hauls averaging about 800 ft. on this 9.2 mi. section. The grading outfit operates two 7-hr. shifts per day and averages 2,500 cu.yd. for each day of full 14-hr. operation. In one exceptional cut, the shovel and trucks moved 3,860 cu.yd. in one 14-hr. day.

A wagon drill puts down the blasting holes in the deep rock cuts on this section. For 4 mi. at the north end of the project, the parkway traverses rough, rocky country. A subcontractor opened a quarry and installed a crushing plant near the center of the project to produce crushed stone for the roadway surface.

*Section 2 A 1* — Of the 12½ mi. of roadway construction involved in this contract section, about 8 mi. crosses open rolling country. Working 10 to 12 hr. a day in earth excavation on this part of the project, a 2-yd. diesel shovel loading material into four track wagons of 8-yd. water-level capacity averaged 42,000 to 48,000 cu.yd. per month. When the shovel had advanced to the pioneering work and hard rock excavation required in the rough, wooded country on the remaining portion of the project, average monthly output decreased to 32,000 to 42,000 cu.yd.

WAGON DRILL swiveled on horizontal member of tubular frame sinks vertical hole in inclined slope. Driller's helper on long plank counterweights machine against overturning.

To produce 42,500 cu.yd. of crushed stone surfacing for the roadway, the contractor opened a quarry outside the limits of the parkway in a solid rock hillside by cutting into the toe of the slope and working back into the hillside until he had developed a quarry face about 25 to 30 ft. high. A wagon drill and four jackhammers put down the holes for quarry blasts, and the jackhammers do the drilling for such re-breaking as is required. A vertical stationary compressor of 320 c.f.m. capacity driven by a 120-hp. gasoline engine supplies sufficient air to run the four jackhammers. When the wagon drill is operating, a portable diesel-powered compressor of 320 c.f.m. capacity hooked up to the air line with the stationary compressor is put into service. Quarry skips picked up by hydraulic hoists on the rear end of light trucks haul rock from the quarry to the crusher. This plant, driven by an 80-hp. diesel engine and equipped with a primary 15x36-in. jaw crusher, secondary gyratory crusher and vibratory screens, produces about 500 tons of crushed stone for roadway surfacing in 12 hr. The contractor has put as much as 700 tons of rock through the plant in 12 hr.



7-YD. WHEEL SCRAPER hydraulically controlled by tractor operator strips topsoil on Section 1R1.

*Section 2 B 1* — Contractors experienced in rock work are handling the grading on this 7¾-mi. section averaging almost 70,000 cu.yd. of unclassified excavation per mile, of which 40 per cent has to be drilled and shot. Cuts and fills on the project run to a maximum depth of 65 ft. on the center line. Rock is found in all degrees of hardness up to mica schist which dulls the bits of wagon drills after 4 to 6 ft. of drilling, and the bits of jackhammers after 2½ to 3 ft. of drilling. Cuts less than 25 ft. deep are drilled to grade, while those deeper than 25 ft. are removed in benches. Wagon drills get 25 ft. to 30 ft. an hour, and jackhammers get 12 to 18 ft.

Six portable compressors, three diesel and three gasoline, furnish the large volume of air needed for the rock excavation. A 450-c.f.m. diesel unit operates a wagon drill; a second diesel machine of 315-c.f.m. capacity supplies air to a furnace and drill sharpener and a third diesel compressor, with a capacity of 315 c.f.m., operates two jackhammers. Two 315-c.f.m. gasoline compressors hooked up in tandem furnish air for one wagon drill and two jackhammers. At the quarry a 315-c.f.m. gasoline compressor is used for operating a wagon drill or two jackhammers as required.

All holes are sprung both in hard and soft rock. In drilling a solid rock face, vertical holes are spaced about 7 ft. apart and are sprung several times with 60 per cent gelatin dynamite (to save exploders). The powder crew then loads the holes with double-deck charges, one at the bottom of the hole and one in the barrel. By using this method to shoot the vertical face of rock cut, the contractor often is able to get large yardages. One such shot broke 2,000 cu.yd. with a charge of 350 lb. of 40 per cent gelatin dynamite.

Shale and tight earth formations too

hard to dig with a 1½-yd. shovel are loosened with black powder. An ordinary shot of 2,000 to 2,500 lb. of powder loosens 5,000 or 6,000 yd.

Two 1½-yd. diesel shovels dig the earth and broken rock on the project. One of these shovels, served by a hauling fleet of three track-mounted tractor trucks of 8-yd. capacity, spends much of its time in pioneering and stripping rock cuts for the drilling crew. The second shovel loads spoil into three 8-yd. two-way-dump track wagons drawn by 60-hp. tractors. This hauling fleet is supplemented by one pneumatic-tired tractor truck of 7-yd. water-level capacity.

Working two 6-hr. shifts per day under the conditions outlined, the two shovels maintain an average of about 1,000 cu.yd. per day for each unit. Average monthly estimates for the job run about 55,000 cu.yd.

*Section 2 C 1* — To drill the large proportion of rock encountered on the greater part of this 11-mi. section, the contractor equipped the job with four gasoline compressors, three of 315-c.f.m. capacity and one of 160-c.f.m. capacity. These compressors are used as required to operate two wagon drills or a number of jackhammers. In ordinary hard rock drilling the wagon drills get 40 to 45 ft. an hour, while each jackhammer gets 10 to 11 ft.

In mountain cuts the wagon drills put down holes to depths as great as 30 ft. When drilling in the side of a mountain with the rock layers inclined at a sharp angle, the holes are loaded both at the bottom and in the barrel to prevent kicking out at the toe, leaving large slabs of unbroken rock on the top. Holes 30-ft. deep are loaded with 16 sticks of 60 per cent gelatin dynamite in the bottom and are filled with about 6 ft. of earth before a second charge of 8 sticks of 40 per cent dynamite is placed in the barrel. As many as 200 holes loaded in this way have been fired at one time, breaking 2,000 to 3,000 yd. of rock in a single shot.

For hauling broken rock the contractor prefers to use five 8-yd. track wagons drawn by 60-hp. diesel tractors. A 1½-yd. oil-engine shovel loads the wagons. A second grading outfit used in earth and rock work on the project consists of a 1¾-yd. diesel shovel and six 4-yd. trucks. The trucks are useful in taking care of the large amount of overhaul on this job.

*Section 2 D 1* — Two grading outfits are in operation on this 13¼-mi. section. One outfit consists of a 2-yd. diesel shovel loading broken rock and earth into 7- and 8-yd. two-way-dump track wagons drawn by 60-hp. diesel tractors. Five track wagons are available for hauling from this shovel, the number in use depending upon the length of haul. Working two 6-hr. shifts per day, the shovel averages between 40,000 and 50,000 cu.yd. each month.

In the second grading outfit are two pneumatic-tired scrapers of 12-yd. capacity drawn by 95-hp. diesel tractors. The two scrapers in a day made up of two 6-hr. shifts move 1,600 to 2,000 cu.yd.

Rock encountered on the project consists principally of laminated sandstone and micaceous rock. Drilling is done with jackhammers. In the early part of the work the rock was fairly soft, and the contractor was able to get a breakage of about 2 cu.yd. of rock for each pound of 40 per cent gelatin dynamite.

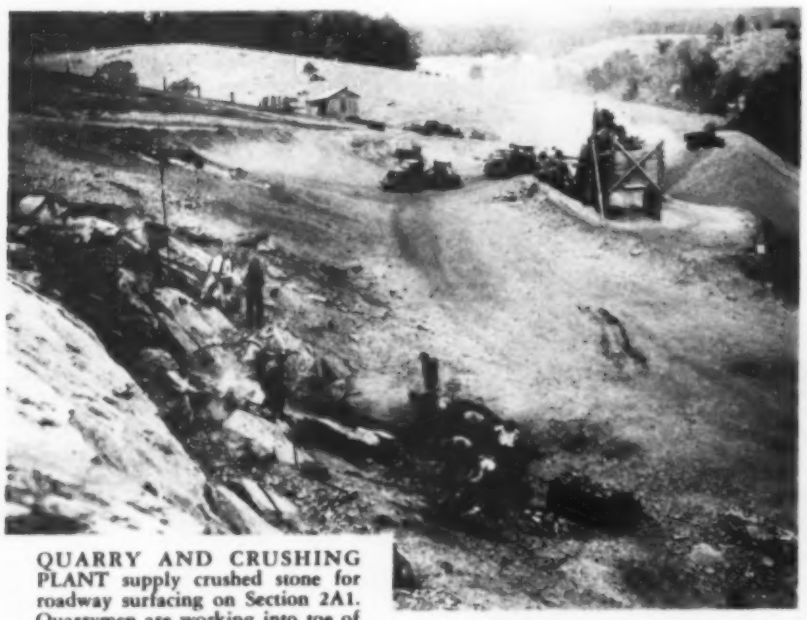
Rock requiring blasting amounts to 15 or 20 per cent of the total excavation. Cuts in earth range to a maximum depth of 60 ft., but cuts in rock do not exceed 40 ft. in depth. Four jackhammers supplied with air by a 420-c.f.m. diesel compressor take care of all the drilling. Holes are limited to a depth of 16 ft., as longer steel would be likely to bind. Because it is believed that additional drilling is cheaper than springing hard rock, a large number of holes are drilled to eliminate the need of springing. Chisel bits sharpened by hand are used on the drill steel to provide steady employment for a blacksmith who thus is always available on the job for any repair work that may be found necessary.

*Section 2 E 2* — On this 8-mi. section averaging almost 60,000 cu.yd. of excavation per mile, the contractor is using two shovels, a 2½-yd. diesel and 1½-yd. gasoline, each served by two large pneumatic-tired tractor trucks which have had their original water-level capacity of 7½ yd. increased to almost 9 yd. by the addition of 7-in. sideboards. The large shovel was brought in to the job to dig rock which a smaller shovel could not handle without shooting. Although the large unit, weighing 56 tons, is slower in the swing and is harder to move in rough mountain country, it traveled 20 mi. to the project from the nearest railroad delivery point in 3 days, cutting its own way in many places.

Cuts on this section run to a maximum depth of 60 ft. The proportion of rock requiring drilling is low, rarely exceeding 10 per cent. In drilling this rock, two jackhammers are giving better service than a wagon drill, the hand-held units getting as much as 900 ft. total distance in 13 hr., while the wagon drill was getting 350 to 400 ft.

Operations are carried on by two shifts per day, a 6-hr. shift in the morning and a 7-hr. shift in the afternoon. In good digging, the large shovel loads 3,500 to 4,000 cu.yd. in one day, and the small shovel loads 2,000 yd.

*Administration*—Construction is directed for the Bureau of Public Roads by H. J. Spelman, district engineer, Washington, D.C., with field activities coordinated under the direction of William M. Austin, senior highway engineer, Roanoke, Va. Construction operations in Virginia are supervised from field offices at Luray, Elkton and Floyd, with G. Y. Carpenter as engineer in charge at Luray, S. L. von Gemmingen at Elkton, and E. G. Middleton at Floyd. All work in North Carolina is under the supervision of A. C. Haygard, engineer in charge, with headquarters in Sparta.



QUARRY AND CRUSHING PLANT supply crushed stone for roadway surfacing on Section 2A1. Quarrymen are working into toe of rock slope.

600 LB. of 60 per cent gelatin dynamite breaks rock on Section 1P1. Diesel 340 c.f.m. and gasoline 315 c.f.m. compressors supply air to two wagon drills.

TWO-WAY-DUMP TRACK WAGONS take rock loaded by 2-yd. diesel shovel on Section 2D1.

# Sodium Lights

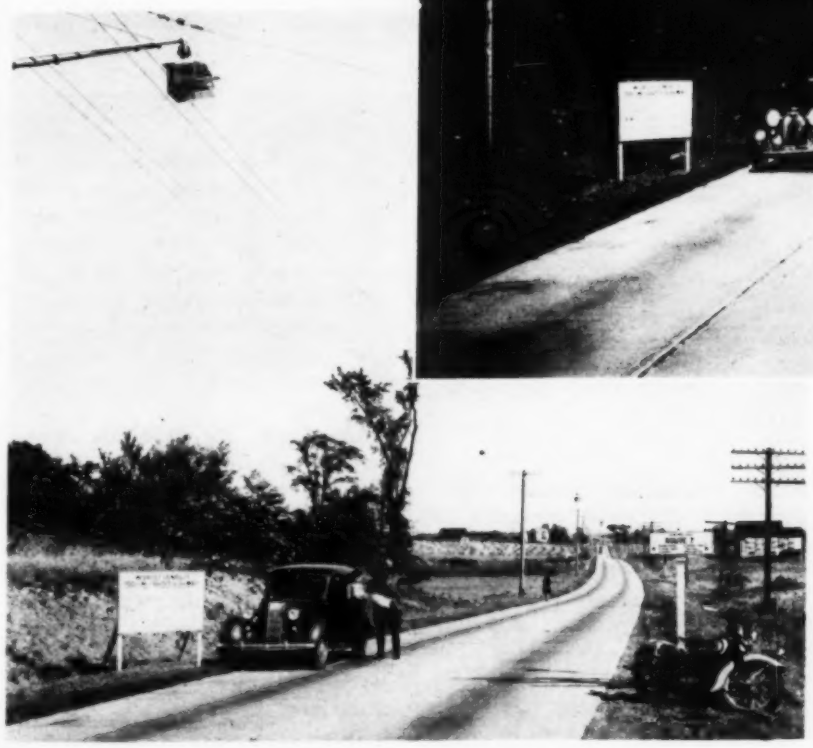
## Make 18-Mile Road

# SAFE

## For Night Driving

**VISIBILITY of exceptional clarity and depth is produced by sodium highway lighting installation.**

SODIUM LIGHTING, producing, without glare, a golden glow evenly diffused by a special "airplane" type luminaire with wing-like aluminum reflector surfaces, has made safe for night driving 17½-mi. of concrete-paved, two lane pavement on New York State Route No. 7, known as the Duanesburg road between Schenectady and Central Bridge, and now constituting the world's longest stretch of sodium-lighted highway. The new type of lamp, product of the General Electric Co., is hung from brackets attached to telegraph or other independent wood poles erected along the road; the lamp unit has an energy consumption of 180 watts and produces a volume of light equal to that of a 500-watt incandescent street lamp. Without concentrated brightness, this light is produced from a flow of electric current through a relatively large volume of sodium vapor and is operated from conventional lighting circuits with only simple auxiliary equipment. A careful coordination of the optical design of the reflector luminaire with the characteristics of the lamp produces the special pattern of light distribution desired for highway lighting.



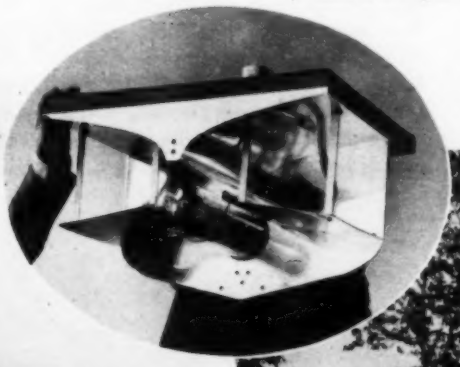
**DAYTIME VIEW of same section of Duanesburg road shown in night view above.**

On the Duanesburg road the sodium lighting units are spaced 240 ft. apart and are mounted on horizontal brackets extending from poles at a height of 25 ft. above the pavement surface, as illustrated herewith. Each of the total of 391 lamps along the 17½-mi. stretch of illuminated highway is a 10,000-lumen, 6.6-amp. series unit. According to estimates of General Electric engineers the service life of one of these lamps averages more than 2,000 hr., necessitating renewal of only two lamps a year. In the design of the luminaires the reflector surfaces are made of Alzak aluminum, a durable, weather-resisting material with an 80 per cent coefficient of reflection, easily maintained at initial brightness.

Installation of the lights and their supporting brackets was done for Schenectady County by the New York Power & Light Corp., with the aid of trucks of two types, one rigged with an extensible ladder and the other with a pipe boom supported by an A-frame hinged on the rear end of the truck for setting new wood poles. The cost of the sodium lighting installation averaged about $1,650 per mile of highway.

Three main advantages are claimed for a highway lighting installation of this type: (1) The proportion of light reaching the pavement and road shoulders is double that obtainable with former equipment. (2) Glare is suppressed by shielding the light source to approximately 10 deg. below the horizontal. (3) On pavement surface uniformity of brightness is obtained, free from areas of low visibility.

**INSTALLATION of luminaires on horizontal brackets is done from extensible ladder on truck.**



**LUMINAIRE, *(left)* with airplane reflectors of aluminum to distribute light for highway service.**

**BOOM supported by A-frame on truck end places poles to carry lighting units.**

PEDESTRIAN PUSH BUTTON *(left)* at semi-actuated traffic signal is pressed by E. F. Copell, traffic engineer, author of accompanying notes.

# Traffic Signs

## for Massachusetts Highways

By E. F. COPELL

*Traffic Engineer, Massachusetts Department of Public Works*

MASSACHUSETTS has been referred to as "the father of modern road improvement." As far back as 1899 a total of 206 mi. of improved (macadam) roadway had been constructed, while today the state highway system alone has increased until it comprises 1876 mi. In addition, there are approximately 1,500 mi. of highways which have been constructed by the Department of Public Works and which form a part of the numbered route system of the commonwealth; of the latter, about 75 per cent are of the improved type.

But it is not with highway improvement, as it relates to construction, that I wish to deal. Rather do I intend to demonstrate that Massachusetts can justly lay claim to similar distinction in her work of posting these highways for the convenience and safety of her motoring and pedestrian public. In the horse and buggy era, the traveler was notified of his whereabouts by means of rudely constructed signboards or stone tablets indicating town boundaries. While at this time the automobile had made its public debut, it was rarely encountered upon our highways. As time advanced, however, the motor car was more in evidence. It became necessary, therefore, to replace the outmoded boundary signs with a more modern type. This resulted in the erection of a sign such as is shown in Fig. 1.

With the advent of the lower-priced cars, the number of motor vehicles found upon our highways, and their mobility, presented a complex problem. Motorists in great numbers, both from within and without the state, either on pleasure or business bent, began traveling to all parts of the Commonwealth. Sensing the inevitable conditions which must result unless this vast army of motorists was marshalled into an orderly procession, the Department of Public Works set about studying the highways and the traffic using them. Finally, in 1925, we undertook to establish a system of directing traffic. Scarcely had our project taken form before the department was deluged by requests from hotel and inn keepers to mark the routes in a manner which would direct motorists to their respective hostelries. It was manifest that such a procedure could but lead to confusion.

*Directional Signs* — Since the primary object in posting the routes was the convenience of the motorist, we finally decided to post the names of towns only. But what towns should we select, and how many names should appear on each sign? This proved a brain teaser. After careful deliberation it was decided to post the route by listing the names of four towns. The signs were to be of sufficient size, and the letters comprising the names, of such a stroke, as to permit of the sign's being easily read.

Accordingly, the following details were evolved: Commencing in a given town, the first name to appear is that of the next adjacent town on the route. The second name indicates the first route junction to be encountered on the route. Next is seen the most important center or town between the route junction and the terminus of the route. The last name shown signifies the terminus of the route.

These signs are to be found at various forks along each route. As the route advances, and at necessary intervals, the names of the towns, save the terminus, change in accordance with the locations. Conditions occasionally demand a modification of the four-name rule. In such instances three names only appear and the lettering in each is greatly enlarged.

We now employ three types of directional signs. (1) A large directional sign is used at route junctions, and in the lightly settled districts. These are usually faced at an angle of 90 deg. to the designated destinations. (2) A double-directional sign is used at the fork of two routes or in places where it is impossible to arrange the necessary information on a single sign. In some instances the reverse side of both of these signs is also used to indicate direction. (3) A directional sign somewhat smaller in size is erected in thickly settled districts and at city intersections. The size of this sign is not only desirable but, due to variations in ordinances and by-laws, is necessary.

For the most part, a 6x6-in. concrete post is used to support directional signs. However, upon city streets, and in keeping with the size of the sign, a 2½-in. iron pipe is employed.

City signs are also faced in a manner to accommodate cross or entering traffic.

In addition to the names which are shown upon all directional signs the mileage from point to point is also indicated opposite to each town. This is taken from a route description book.

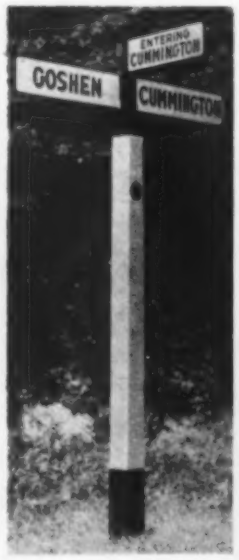



Fig. 1 . . . TOWN LINE SIGN marks boundary between communities.

TRAFFIC CIRCLE sorts and separates traffic streams from intersecting highways at important junction. All traffic turns to right both when entering and when leaving circle, eliminating objectionable left-hand turns.

## *Warning and Directional Signs*

Fig. 2 . . . BILLBOARD TYPE of directional sign provides long-range visibility for fast-moving traffic on trunk routes. For legibility at night, signs at left and right are completely reflectorized, while sign in center is illuminated by two overhead floodlamps.

Fig. 2 *(continued)* . . . DIRECTIONAL SIGNS of various types erected at junctions in cities and towns are designed to give essential information in highly legible form within limits imposed by local conditions and ordinances. (a) Tabs are attached to concrete post carrying directional signs. (b) Signs indicate overlapping routes. (c) Old and new types of signs show trend to better appearance. (d) Supplemental panel under single-directional sign designates local road joining state highway. (e) City sign gives distance to one town in each direction. (f) Double-directional sign in city is set on iron post.

Fig. 3 . . . WARNING SIGNS of plain and reflectorized types indicate various road and traffic hazards. Where definite, constant danger is involved, signs are equipped with reflector buttons for night driving.

Fig. 3 *(continued)* . . . SAFETY of cross-traffic and pedestrians is served by some highway warning signs.

Fig. 4 . . . FLASHING NEON SIGN warns fast-moving traffic of dangerous turn on rural section of state highway.

Fig. 5 . . . ROUTE MARKERS, tabs and directional arrows studded with glass buttons aid motorist at intersections. Right and left turns are indicated by "R" and "L" tabs some distance in advance of intersection.

Fig. 6 . . . REFLECTORIZED STOP SIGN is erected close to roadway in side street to assure reflection of rays from headlights of approaching vehicles.

The mileage on all routes is ascertained by an inspector whose work it is to travel the route in both directions. The accuracy of the mileage is made certain by using two speedometers on the car. One of these is connected with the transmission and the other is attached to the right front wheel. In addition, the tires are regularly checked and the car kept in good mechanical condition. Examples of the various types of signs referred to are shown in Fig. 2.

*Warning Signs* — After our routes had been posted so as to give proper direction to the motorist our attention was then turned to searching out hazards upon the highways. Since these dangers were of different degrees, the type of warning sign and legend thereon varied.

In order to indicate an ordinary hazard, where the danger was more or less apparent, a plain warning sign was used. These carried a legend such as "School", "Cross Road" "Road Left", "Road Right", "Pedestrians", etc. For a more definite hazard a sign equipped with reflector buttons was used. In the latter the buttons are inserted within the stroke of the letters which com prise the legend. This type of sign is particularly effective where, owing to lack of electrical current, the erection of a more definite type of warning is impossible. Some of the types of warning signs which we use are represented in Fig. 3.

While the speed of traffic in relation to a given hazard determines the location of warning signs erected between intersections, those indicating a cross-road are approximately 200 ft. removed from the intersection. We have in the neighborhood of 7,000 warning signs.

At some locations between intersections hazards are found to exist which require more than ordinary treatment. In such cases the department employs the flashing Neon warning sign. The tube of this sign forms the legend for whatever the particular hazard may be. One of these is shown in Fig. 4.

*Route Markers*—We next concerned ourselves with the actual numbering of all routes. To our knowledge such a method had never before been employed by any state. In fact, the existing method of denoting a route was that established in 1921 by the Department of Commerce during the regime of Secretary Herbert Hoover. This consisted in painting the utility poles with bands of various colors. Red, white, blue and yellow were, I think, the most commonly used.

Early in 1925, therefore, my department commenced numbering certain highways by painting route numbers on utility poles. Those highways which extended from east to west across the state were indicated by even numbers, and those stretching from north to south were designated by odd numbers. In order that the figures might be easily read, black numerals were superimposed upon a white background.

It was not long before the disadvantages of this method of marking became apparent. Some poles bearing the route numbers were replaced, while

Fig. 8 . . . FLASHING BEACON denotes hazard and stops traffic on side streets entering main highway.

## *Step-by-Step Method of* SIGNAL INSTALLATION

**1** SERVICE CONDUIT to carry electric wiring to semi-actuated traffic signal is laid and connected in trench.

**2** SERVICE RISER to electric power line is erected alongside wood pole.

**3** TEMPLET placed on forms holds anchor rods in position while base is concreted.

**4** WORKMAN *(right)* splices cable leads to signal housings. Completed traffic signal appears on first page of this article, with Mr. Copell pushing pedestrian button.

others were treated with a weather-proofing preparation which utterly obliterated the numbers. Added to this was the request received from the Federal Government and officials of adjacent states that we cooperate with them in numbering routes. But our principal reason for abandoning this system was the fact that the figures were not discernible at night.

Because of these factors the Department of Public Works, in 1926, resorted to the use of metal route markers which were studded with glass reflecting buttons. Before 1928 had come to a close the Federal routes numbered 1, 3, 5, 6, 7, 10 and 20 had been equipped in this manner. By 1931 each numbered route in the state bore the new type of route marker. Including the "R's", "L's" and directional arrows, which are incidental to the route numbers, there are approximately 15,000 route markers on the highways of this Commonwealth.

*Posting of Route Markers* — Route markers are posted singly or in conjunction with "R's" or "L's" or directional arrows. A combination of all three is possible and will be found at some locations.

Following the completion of turns or crossings the route marker is used singly for confirmatory purposes, and in such cases is located beyond the intersection and at a point that is easily visible to approaching drivers. It is also used alone to direct traffic straight through a cross-route or artery.

In every instance where the route diverges, the "R" or "L" is placed some distance *in advance* of the turn. If one route is crossed by another the double arrow is employed to denote such crossing of routes. Again the marker is erected sufficiently *in advance* to warn of this condition.

Fig. 5 represents one of the uses of the combination route marker, "R" tab and directional arrows.

*Isolated Stop-Signs* — In addition to those signs whose chief purpose is to warn of danger, the department uses another sign to safeguard the motorist upon an entering way. These we term "Stop" signs. They require the operator on the side street to come to a complete stop before entering the main highway. Such signs are erected at intersections where the view of the approaching driver is obscured or where, because of fast traffic on the main road, his safety demands careful operation. In use, it is akin, in an isolated manner, to the well-known Through Way sign. The sign is located in the highway, as may be seen from Fig. 6, so as to permit the buttons to reflect the rays from the headlights of oncoming vehicles.

*Traffic Markings* — There is still another type of traffic sign which is extensively used in our Commonwealth. Unlike the mounted sort, this is painted upon the highway. I refer to painted white-lines, generally known as traffic markings. These markings are capable of so many uses that an explanation of them would require a separate article. A few of the types will, therefore, have to suffice. The painted solid white-line is used widely as a center-line to mark the middle of the traveled way. Shorter lengths of solid lines have the effect of restricting or regulating. The broken white-line makes an admirable channelization and guide-line. An idea of the effectiveness of two of these types may be gathered from Fig. 7 given below.

Many other uses are to be found for white lines — cross-walks, stop-line, parallel parking, etc. This type of sign is both efficient and inexpensive.

**Fig. 7 . . . TRAFFIC MARKINGS on four-lane roadway mark center line by solid stripe and lane channels by broken stripes.**

*Flashing Beacon* — There is also a device that the department employs which not only denotes a hazard, but which also requires that the vehicle on the side street be brought to a stop before entering upon the main highway. These we term flashing beacons. They are located at intersections where the entering traffic may be comparatively light, but where the accident history has been such as to establish their need. About 200 of these devices have been erected upon our state highways. (See Fig. 8.)

*Traffic Control Signals* — When it is found that conditions at a given intersection are such as cannot be remedied by any of the methods to which I have already referred, and the volume of traffic warrants, the department installs traffic control signals. This, in fact, is one of the chief functions of the Traffic Division.

The functioning of traffic signals is generally well known. It may be of interest, however, if I give a resume of the development of signals in our state. Upon the entrance of the department into the field of traffic control two types of signals were available, one, the pre-timed type, either electrically or manually operated, and the other, the vehicle-actuated type. Each was found to have its own merits under certain physical conditions.

The pre-timed controllers were manufactured by a number of companies: their cost was determined by the type and they were practically without uniformity. On the other hand, the vehicle-actuated systems were practically controlled by a single concern. Since the apparatus could not be purchased, its use was possible only through rental, making such use almost prohibitive.

It is obvious that the department was faced with a dilemma. Its first task was to establish a standard of uniformity and to encourage the development of a better timing mechanism. In fact, the following changes in timing sequence were instituted by our department: (1) The adoption of a direct warning period following a green indication, thus eliminating the dangers attendant upon a burned-out yellow bulb, which, in a dead condition, would cause the signal to change directly from green to red. (2) The installing, when necessary, of a pedestrian period (red and amber) in a cycle. (3) The adoption of an all-red clearing period, of about 3 sec. duration, to inform the pedestrian that his period is about to expire. (4) The installing of pedestrian push buttons. This innovation, while affording sufficient time for pedestrians to cross, also causes a minimum of delay to vehicular traffic. (5) The creation of a flashing green installation. This type of control exists at those locations where pedestrian protection is required and where vehicular traffic does not demand the normal form of signal control. The function of the flashing green signal differs from that of the flashing yellow. In the case of the latter, the indication remains constantly the same, whereas, the former is likely to change.

*Traffic Signal Tests* — Having achieved considerable success in the standardization of signals, the Traffic Division next sought to achieve uniformity in operation. As the traffic equipment furnished by the manufacturers of signal devices did not always meet the requirements set forth in the timing and sequence specifications, it was imperative that tests of these mechanisms be made before the signals were actually installed. In this manner complete knowledge of their functions could be ascertained. This resulted in the erection of a test board to which any traffic control signal timer could be easily connected. This board is designed to reproduce the exact conditions which exist at the intersection.

Following this method of checking the timing of controllers and all other traffic equipment, the department then adopted a comprehensive maintenance program. A skeleton of the program follows:

(1) A 24-hr. maintenance emergency crew was established.

(2) A complete stock of electrical and mechanical parts necessary for any type signal breakdown was stocked.

(3) A bulb replacement schedule was inaugurated.

(a) Since a proper bulb schedule is most vital to the safe operation of any traffic control installation, and because this particular schedule has been taken up by cities and towns throughout the United States, I wish to enlarge upon this slightly.

In an attempt to reduce the number of maintenance calls to traffic control signals resulting from burned-out bulbs and to lessen the hazard created by blank indication, an extensive study of the factors affecting the mortality of bulbs was made.

It should be undertsood that the length of time during which each indication is lighted varies in accordance with the timing required at a given intersection. For example, an amber period of a timing cycle may extend from 3 to 5 sec., a green indication may be from 12 to 60 sec. duration and the red indication will likewise vary. It was necessary, therefore, to consider each light as a separate unit. These units were divided into various classes. Through such segregation it was possible to determine the definite life of bulbs in each class and to reduce the number of burned-out bulbs to within 2 per cent of the total number in use. The definite knowledge of the exact life of a lamp which was thus obtained was insurance against burned-out bulbs.

It is interesting to note that the adoption of such a schedule as I have outlined is superior in at least one respect to the use of the double-filament bulb which has been recently introduced.

One of the advantages, if not a requisite, of a signal indication is that the full beam be clearly seen at a safe distance from the intersection. This is not possible with this new type of bulb because, when its life is about to expire, one half of the lens becomes darkened.

The use which the department makes of numerous other devices and signs might well be treated, but space does not permit. It may not be amiss, however, before concluding, merely to designate a few of these other signs: Divisional Island; Safety Island; "Keep to Right"; "Right Turn Only"; warning-regulatory signs which combine a legend and a symbol; Traffic Circles; and Underpasses and Overpasses.

## *Ohio Highway Paved With*

# NEW AND SALVAGED BRICK

SALVAGING A PORTION of an old brick highway and constructing an adjacent all-new section on 2.646 mi. of U. S. 422, the Youngstown-Warren road in Trumbull County, Ohio, were the chief features of a project completed late last year by the Victor Olson Construction Co., of Youngstown, Ohio. This contract, which was awarded April 10, 1936, by the Ohio State Highway Department called for grading, constructing drainage structures and paving with new and salvaged brick surface course.

*Plan and Design Features* — Careful study of the existing alignment, the testing of the existing base and brick wearing surface showed that a portion of the existing base could be salvaged. Also, the existing brick surface could be partially salvaged and relaid. The design of the typical all-new section consists of an 8-in. reinforced concrete base, ¾ in. of powdered asphalt mastic cushion, 4-in. salvaged brick and 3½-in. new brick. The width of wearing surface is 28 ft. 3 in. of brick, with one 9-in. flush concrete curb and one 12-in. rolled curb. The pavement has a full crown on the right or 20-ft. side in accordance with the standard 40-ft. pavement crown, which is 4 21/64 in; on the left or 10-ft. side the crown is 1 39/64 in. This crown on the left is so designed that when an additional 10 ft. are added a full crown may be developed. Federal regulations as to horizontal and vertical site vision were complied with, except for one location where the gradient was such that it required the construction of 1,300 ft. of extra 10-ft. width for safety.

The right-of-way is 80 ft. in width. All portions not used for pavement purposes will be improved by seeding and planting in accordance with state standard methods of roadside improvement. Through a school area a 3-ft. compacted cinder walk will be constructed on each side for safety to children.

*Subgrade* — The preparation of the subgrade was made in accordance with the standard state highway compaction layer method. Curve charts showing the moisture content necessary to develop the maximum compaction for the material used were developed in the state highway testing laboratory at Columbus for use in the field. Four charts were made from four roadway cut sections ranging from 3 to 7 ft. in depth and from three borrow pits having a maximum cut of 10 ft. The additional water necessary to give maximum compaction was applied by means of tank trucks and sprinklers.

*Reinforced Concrete Base*—The base was finished to its proper crown and grade with two Heltzel Flex-Plane finishing machines having on the front machine screed a movable strike-off plate which could be dropped down several inches below the finished crown surface to allow the reinforcing mesh to be placed at its proper depth in the slab. The joints, both transverse and longitudinal, were constructed by a Heltzel joint machine, cutting and placing the 3½-in. bituminous ribbon in its proper position. The dowel bars at the transverse joints were held in place by Truscon bar chairs consisting of a very rigid welded bar frame to which ¾-in. round dowel bars were held in place by a snap clip. The standard method of curing by use of straw covering and water was applied until the slab developed its required strength.

*Powdered Asphaltic Mastic Cushion* — The powdered asphaltic mastic cushion was made in a standard twin pug-mill batch type plant. The aggregate was dried at the lowest possible temperature required, depending on the weather conditions and the moisture content of the aggregate. The conditions required the passing of the material through the rotary dryer twice to obtain a temperature of the aggregate at 150 to 200 deg. F. The aggregate was then accurately batch weighed and introduced into the pug-mill. The flux oil was then added at a temperature of 175 deg. F., and the materials were mixed to uniformity. The powdered asphalt was added the full length of pug-mill slowly and evenly, the mixing time, after addition of powdered asphalt, being approximately 30 sec. Care was taken at this point with the operation of adding powder, for if this is not accomplished as described, the mixture develops an excess of large, hard balls. Also, if the mixing time at this point is increased, the material will flux too fast and give a hard, quick-setting mixture on the street. The finished product had a temperature of 180 to 200 deg. F. in the truck.

The flux oil and powdered asphalt were carefully weighed. The powdered asphalt must be passed through a wire-cloth screen having openings of ⅛ in. to prevent balling. The paddles in the mixing box were set at least ¼ in. from the liner of the box and as close together as possible, so as to give the least space on the liners for material to collect; otherwise, the material would adhere to the liner and eventually build up to such a point that it would break off in hard balls into the mixture. A very careful check of the mixing box was maintained to keep it clean so as to prevent balls forming from this cause.

The mixture used was 89 per cent aggregate and 11 per cent bitumen. The bitumen blend was determined from samples sent to the state highway testing laboratory at Columbus. A blend of 55 per cent flux oil and 45 per cent powdered asphalt was found to give the desired 85 penetration. The weight of the batches was 2,000 lb.

The graduation of the aggregate was as follows: Passing ⅜-in., screen, 100 per cent; No. 4 screen, 95 to 100 per cent; No. 8 screen, 70 to 90 per cent; No. 16 screen, 45 to 75 per cent; No. 30 screen, 20 to 50 per cent; No. 50 screen, 5 to 25 per cent; No. 100 screen, 0 to 5 per cent.

Carbon limestone sand and Massillon washed bank sand were used for aggregate. In the use of limestone aggregate the best results and the least balling in the pug-mill were obtained by adding the powdered asphalt to the dried sand and mixing dry before adding the flux oil. With the use of bank sand the flux oil was added before the powdered asphalt to prevent balling.

The material was delivered to the street in covered trucks losing from 5 to 10 deg. F. in a 10-mi. haul. The bed was prepared in the following manner: A dump board of ¼-in. steel plate, 8x8 ft. in size, received the mixture from the trucks; it was attached to the trucks and moved forward as needed. The bed was shaped by the use of a Heltzel finishing machine, the screed being used as a strike-off templet. The reciprocating motion of the screed on the finishing machine was tried but found to make the bed ridgy instead of smooth and fluffy. The machine was self-propelled and traveled on a specially constructed interlocking rail of 10-ft. lengths which was placed on the concrete base next to the rolled curb; on the flush curb side it was necessary to use 3½x3½-in. interlocking angle of 10-ft. lengths. These rails could then be advanced from the rear as the machine went forward. The curb and base next to the curb were very carefully straight-edged at the time of finishing the concrete base to insure perfect grades when the cushion machine was to be used.

The machine was then run forward with a steady smooth movement having at all times a surplus of cushion in front of the screed. When it was necessary to stop the machine between loads or at the end of a day's run the cushion was cut off at right angles to the curb. At the end of each day's run approximately 20 ft. of cushion was

ROLLER CONVEYORS deliver brick from both shoulders of road to droppers placing wearing course on sand-mastic cushion of 30-ft. pavement in Ohio.

left open to allow the machine to start the next day.

After the finishing machine had prepared the bed it was found advisable and necessary to straight-edge the cushion back of the machine so that the high spots, ridges and low spots could be fixed. If this was not accomplished at this time it would be necessary to surface-heat the high spots and ridges in order to remove them. Care was also taken to remove the balls that might be in the cushion and fill whatever streaks these balls might have formed in the bed. The cushion worked best when in a semi-fluffy condition at a temperature of 180 deg. F. and not over 200 deg. F.

FINISHING MACHINE strikes off mastic cushion to true grade and profile for brick surface course, being laid close behind machine. Cushion material is dumped on pan by truck.

CONCRETE MIXER prepares grout filler for joints of brick wearing course. Surface is checked before filler is applied.

The usual brick procedure was used in the laying, culling, testing, straightening of lines and placing of premolded joint material with the exception that the brick laying was kept close to the finishing machine. The rolling was also kept up close to the brick droppers. This was accomplished by taking short strips for rolling instead of the usual lengths as with slag or sand cushion. When the cushion has not fluxed or surface-hardened a smoother surface and a more even compaction were obtained. A 10-ton tandem roller was used for rolling the brick; it gave a good compaction and embedded the brick into the cushion to the desired depth. By having the roller close to the bed-making operation the cushion remained soft enough to roll out the high spots and the ridges in the same manner as rolling them out on a bituminous wearing surface by cross rolling. If the cushion were fluxed so as to give a harder surface then the bricks had to be removed and cushion surface heated to remove high spots; low spots were repaired by the usual manner of building up the cushion and then re-rolling that section.

*Joint Filler* — The brick filler on this project was a cement grout composed of a mixture of portland cement, lime, sand and water, mixed in the proportions of 2 parts cement, 1 part hydrated lime and 6 parts sand, standard proportions. The grout was mixed in a 2-sack mixer with accurate water control and timing devices. The grout was applied in three coats. The first or filler coat was applied and allowed to settle before second coat was started. Then, after sufficient time had elapsed to allow material to settle, the finished coat was applied. The method of placing grout on the pavement was by a long chute attached to the mixer and swung around to place grout on the brick. The mixer was run on planks so that no low spots or ridges would be formed by the mixer wheels. Because of cold weather the mixing water was heated by means of a large heating coil. The pavement then was covered with approximately 12 in. of straw to protect and cure it.

*Salvaged Old Brick* — The old brick removed from the existing pavement were coated with asphalt, emulsion and tar. The brick were all removed, approximately 21,000 sq. yd., by means of a Keystone shovel with skimmer scoop, loaded into trucks and hauled to a large field for cleaning.

When cleaning operations were started the weather condition softened the bituminous material on the brick, making it impossible to remove it with hatchets. A shaver or pealing machine was developed consisting of a large knife-edge blade welded to a 1-in. pipe 5 ft. long, one end of which was hinged to a low bench and the other end having a handle. A brick could be held at a slight angle on the bench with one hand and with the other the knife could be pulled down and shave or peel off the bitumen material from the faces of the brick. The brick were then culled and stacked in the yard.

About 12,050 sq. yd. of salvaged brick pavement was relaid. The remainder, or about 42,400 sq. yd., was laid with 3½-in. new wire-cut brick of vertical filler type with lugs on one side and two ends. These brick were manufactured by The Metropolitan Brick Co.'s Bessemer plant.

*Progress* — The progress of this project was well within the required time limit of allowable working days — 175 days being allowed and at this writing 110 days have been consumed with 82 per cent of the work completed.

*Personnel* — The project was constructed for the State of Ohio and the Federal Government by the Victor Olson Contracting Co., of Youngstown, Ohio. The laying of the brick was sublet to Ted and John Siewiorek Co., of Cleveland. The state and Federal bureau are represented by Archie A. Ranney, division deputy director and George W. Holman, assistant division director in charge of construction. Harry L. Dittmer is the resident engineer and Henry J. Waldeck project engineer reporting to John Jaster Jr., state director of highways.

10-TON TANDEM ROLLER *(left)* beds brick in mastic cushion. Damaged brick are removed and replaced.

GROUT FILLER is brushed into joints of brick course. Heavy straw covering protects grout during curing period.

THREE HYDRAULIC LIFTS provide definite control of depth at which hollow teeth are set to inject oil below surface of soil road.

# Sub-Oiling of Soil Road

## Produces Stable Base for Surface Mat

SUB-SURFACE OILING of soil roads to produce stabilized bases for thin wearing courses is undergoing its second year of trial in Missouri. By this process liquid bituminous material under pressure is deposited several inches below the surface of a scarified soil road containing a proper amount of moisture. Natural forces cause the bituminous material to diffuse upwards and permeate the mass, coating the soil particles with bitumen at a fraction of the cost of producing the same mixture by mechanical means. In 1935 the Missouri State Highway Department built an experimental section 10 mi. long by the sub-oiling process, and in 1936 contracted for and built 52 mi. The last project completed involved 20 mi. of 22-ft. base 4 and 5 in. deep on state route 5 between Keytesville and Marceline. Here the Midwest Pre-Cote Co., of Kansas City, Mo., contractor, applied the bituminous material with a sub-oiling machine illustrated by accompanying photographs.

*Sub-Oiling Theory* — In the sub-oiling process water and the bituminous material are deposited below the surface at a depth corresponding to the thickness desired in the stabilized material. Dr. Hans Winterkorn, of the University of Missouri, explains the action of the two liquids as follows:

"Because of its affinity for the constituents of the soil, the water wets the soil and, compelled by its high surface tension and aided by its low internal friction, starts to spread radially throughout the soil. In the course of the diffusion of the water, the air occupying the soil-pores has to be expelled. This is more easily accomplished by upward- than by downward-moving water. As a result the water-movement is practically entirely upward. As the water fills the pores, expelling the air therefrom, the volume of the system decreases. The energy for this contraction is furnished by the energy of wetting the soil-particles by water, by the difference of the vapor pressure of pore-water from that in the outside atmosphere, and to a very great extent by the action of the various kinds of rollers used.

"The oil follows the water in its movement first through the larger fissures and pores, then into the smaller spaces and micropores. By evaporation the amount of water decreases more and more and its place is taken by the succeeding oil."

In this way the sub-oiling method utilizes the forces of nature to accomplish what is done by costly manipulation in other methods. As the presence of moisture is desirable rather than objectionable, the process may be carried on with a minimum of delays caused by weather conditions. Because of the small amount of equipment and manipulation required, traffic can pass through a project without inconvenience.

4-IN. ASPHALT PUMP on sub-oiling machine draws bituminous material at 150 deg. F. from tank truck and forces it through manifold pipes to hollow teeth mounted on tubular A-shaped frames.

*Sub-Oiling Machine* — To introduce the bituminous material at the specified depth below the surface the Midwest Pre-Cote Co. used an Ingalls sub-oiling machine equipped with 31 scarifier teeth having ¼-in. diameter vertical holes through which oil was pumped by a 4-in. gasoline-powered asphalt pump mounted on the machine. Oil pumped through the teeth was deposited under the road surface at the rear of each tooth. The hollow teeth were mounted in series on the two legs of an A-shaped frame suspended from three hydraulic cylinders which controlled the depth of application of the oil. Spacing of the teeth on the A-frame was so arranged that they made small furrows 3 in. apart when they were pulled through the soil of the road.

A pneumatic-tired carriage similar to that of a blade grader supported the A-frame and the asphalt pump. The sub-oiling machine was pulled by a 60-hp. tractor and was followed by a 700-800-gal. tank truck from which the pump drew bituminous material through a 4-in. hose. Manifold pipes conveyed the material from the pump to the teeth. The machine covered 7½ ft. of roadway at each trip. A governor on the gasoline motor synchronized pump speed with forward speed of the machine, assuring uniform application of material. Other aids to accurate control of the sub-oiling operation were a tachometer on the pump shaft and a speedometer on the tractor. Oil flow was controlled by a valve, with a by-pass in the pump to take care of return oil. Hydraulic controls were used for steering as well as to regulate the depth of the teeth.

*Base Design* — For the 20-mi. project between Keytesville and Marceline the Missouri Highway Department designed a 22-ft. base composed of two 7½-ft. edge strips 5 in. deep and a 7-ft. center strip 4 in. deep. The crown is 2 in. Because the existing road was low in granular material the contract called for the addition of 17.4 tons of gravel per station (100 ft.) Oil to the amount of 2 gal. per square yard was deposited in two applications. On the south 10 mi. of the project, the engineers called for slow-curing oils and on the north 10 mi. for medium-curing oils.

*Moisture Content of Soil* — Specifications required that, unless otherwise directed by the engineer, at the time of application of the bituminous material the moisture content of the soil fraction passing a No. 40 sieve should be not less than 7 per cent for sand, not less than 10 per cent for silt and not less than 15 per cent for clay. To add water on dry grade the contractor used a second Ingalls sub-oiling machine of an older type which had built the 1935 projects in Missouri.

*Job-Mixed Emulsion*—Another paragraph of the specifications provided that if, in the opinion of the engineer, it became desirable to emulsify bitumi

nous material used in the base stabilization a quantity up to 50 per cent of both the slow-curing and medium curing bituminous material should be emulsified on the job. The contract contained items for this emulsifying, as noted in the accompanying table of contract prices. A portable emulsifying unit prepared emulsified asphalts at the railroad unloading sites.

*Progress*—Three tank carloads of bituminous material, 30,000 gal., supplied oil for about 6,000 ft. of base. The sub-oiling machine frequently took this amount of material in a day of 10 to 12 hr. When hauling the maximum distance of 10 mi. from either of two unloading points the contractor used six tank trucks holding 700-800 gal. each. A general average for the sub-oiling machine can safely be stated as 1 mi. of completed base per day.

*Construction Procedure*—In practice the first step consists in scarifying the roadway, to the prescribed depth of stabilization. On the project on state route 5 the additional granular material was deposited on the roadway and was spread and maintained to a uniform thickness prior to scarifying. The roadway then was scarified with a rooter using five teeth in normal subgrade and three teeth in hard-baked subgrade. Scarifying was limited to the depth of application of the oil. If additional water was required it was applied by the older sub-oiling machine.

**Contract Quantities and Prices**

| *Item* | *Quantity* | *Unit Price* | *Amount* |
|---|---|---|---|
| Manipulation, mi. | 19.99 | 800.00 | 15,992.00 |
| Granular material, tons | 18,381 | 2.10 | 38,599.80 |
| Water, 100 gal. | 10,555 | 0.70 | 7,388.50 |
| Bit. material (med. curing), gal. | 258,240 | 0.089 | 22,983.36 |
| Bit. material (slow curing), gal. | 258,240 | 0.07 | 18,076.80 |
| Emulsify med. cur. bit. mat., gal. | 129,120 | 0.06 | 7,747.20 |
| Emulsify slow cur. bit. mat., gal. | 129,120 | 0.06 | 7,747.20 |
| Bit. mat. for surf. treat. (Med. cur. or primer for 1st application), gal. | 56,810 | 0.10 | 5,681.00 |
| Bit. mat. for surf. treat. (Rapid curing for 2nd application), gal. | 82,170 | 0.095 | 7,806.15 |
| Cover material for surf. treat., tons | 4,107 | 3.00 | 12,321.00 |
| Total | | | 144,343.01 |

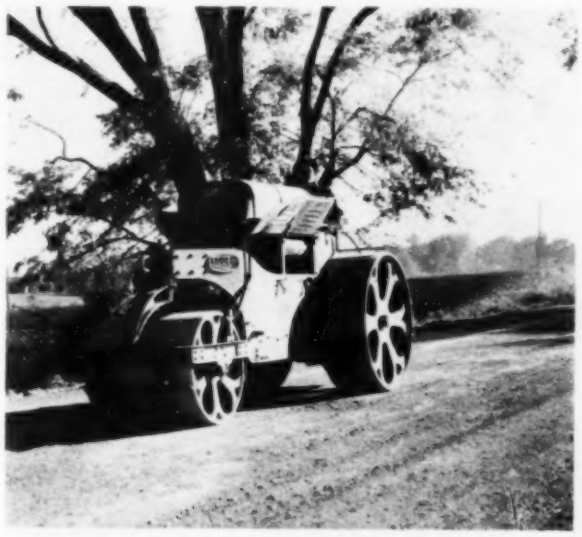
**QUANTITIES and costs of actual construction varied from estimates given in table. For three divisions of work, actual costs per mile of construction were: (1) added granular material, $1,929.71 per mile; (2) stabilization, $3,161.63 per mile; and (3) surface treatment, $1,291.05 per mile. Total cost of project was $127,584.06, or $6,382.39 per mile.**

To avoid any impairment of the accurate operation of the sub-oiling machine, bituminous materials were delivered to it at a temperature of 150 deg. F. Immediately after application of the bituminous material the surface was bladed lightly with a motor patrol grader to eliminate ruts and minor surface irregularities, care being taken not to disturb the oil-impregnated layer. As part of this same operation the road was compacted with a conventional pull roller or a sheepsfoot roller. Throughout the curing period, which normally lasted one to two weeks, the road was given light maintaining by a grader and 5-ton roller.

*Results* — Following indications of success on road construction for Jackson County, Mo., in 1935, the state set aside 10 mi. in Platte County for further tests of the sub-oiling process. To gain more complete knowledge of the method, the road was divided into 46 sections, each of which received a different kind of treatment. A wide variety of materials, including various grades of slow-curing and medium-curing asphaltic materials and several types of asphalt emulsions, was applied on these test sections. To determine what quantity of oil would give the best results the amounts applied ranged from 1¾ to 5½ gal. per square yard for a 4-in. thickness. The tests also investigated the feasibility of adding granular material as a means of reducing the quantity of oil required and of imparting additional stability to the mixture. Projects built in 1936 were designed on the basis of results obtained in these tests.

Because of the lateness of the season it was impossible to add a wearing course to the test road in 1935. A surface treatment to protect the base from the abrasion of traffic had to wait until the spring of 1936. The project has carried traffic on the stabilized base through the severe winter of 1935-36 and on the surface mat through the hot summer of 1936 without any sign of distress.

*Administration* — C. W. Brown is chief engineer of the Missouri State Highway Department, and F. V. Reagel is materials engineer in charge of research leading to the testing of the sub-oiling machine in Missouri. The 20-mi. stabilization project on state route 5 was built under the general direction of H. M. Brush, division engineer, Macon, Mo., with E. R. McKee, project engineer, in active charge in the field. For the Midwest Pre-Cote Co., Frank L. Carswell is vice-president, and T. H. Cutler, Jr., was superintendent in charge of the work. The Ingalls sub-oiling machine was built for Sub-Oiling, Inc., of Kansas City, Mo., by the Firman-Carswell Mfg. Co., of Kansas City, Kan.



**AFTER SUB-OILING, surface of soil road is bladed and rolled with 5-ton three-wheel roller.**

**DRAWN BY TRACTOR and followed by tank truck, sub-oiling machine applies bituminous material below surface of soil road through 31 hollow teeth covering total width of 7½ ft. of roadway per trip.**

**IN CHARGE of operations for Missouri Highway Department on Keytesville-Marceline contract: (left to right) W. H. Thompson, inspector, and E. R. McKee, project engineer.**

**WHEN TANK TRUCK is emptied, it backs away and fresh tank takes its place.**

# *Step-by-Step Field Methods*

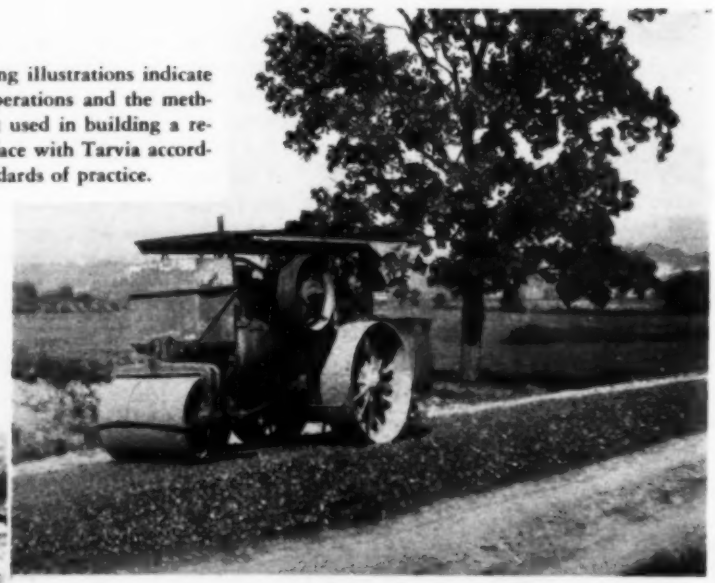
## Current Practice in Building a

# TAR RETREAD SURFACE

• The accompanying illustrations indicate the sequence of operations and the methods and equipment used in building a retread highway surface with Tarvia according to current standards of practice.

**1** STONE of 1-in. size is spread upon road subgrade to loose depth of 2½ in., with aid of spreader box attached to rear end of motor truck.

**2** APPLICATION of HOT TAR to layer of crushed stone is made by pressure distributor at rate of 0.8 gal. of Tarvia per square yard of surface.

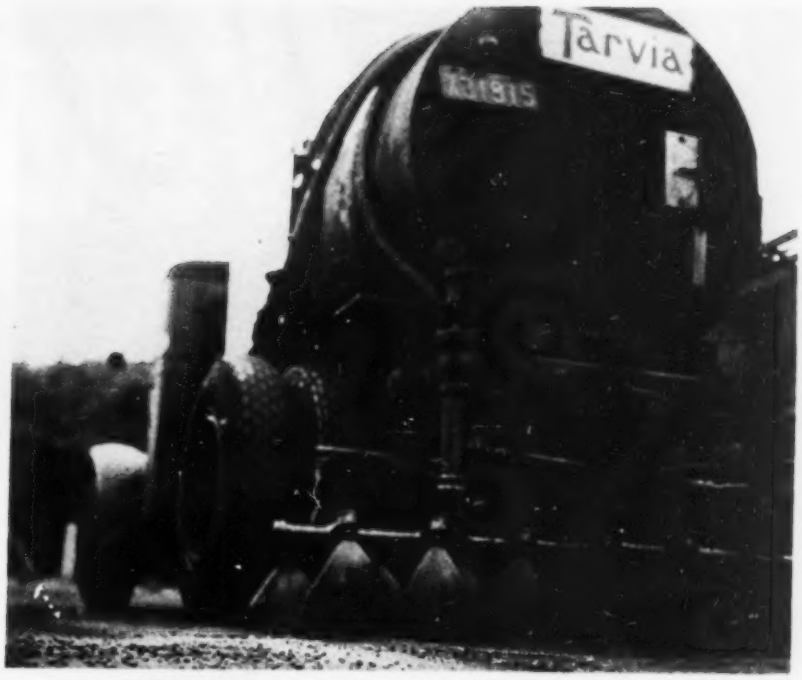


**4** PRELIMINARY ROLLING is usually done with 10-ton, three-wheel power-driven unit, although successful work has been accomplished with lighter rollers. This preliminary rolling shapes the road surface in two or three passes.

**3** MIXING AND SPREADING of tar-treated crushed stone is done by self-powered blade grader equipped with pneumatic tires.

**5** CHOKE STONE is spread on road surface, after shaping and compaction by rolling, in amounts of 10 to 15 lb. per square yard. Material may be crushed stone, slag or gravel (designated as No. 5-B, modified) of following sizes: Passing ½-in. sieve, 100 per cent; passing ⅜-in. sieve, 90-100 per cent; passing No. 5 sieve, 10-30 per cent; passing No. 8 sieve, 0.8 per cent.

**6** WIDE BROOM attached to roller distributes choke stone to produce even surface.




**10** FINAL SEAL COAT of ¼ gal. of hot tar per square yard is sprayed on to surface of road by pressure distributor.

**7** SECOND APPLICATION OF HOT TAR for first, or penetration, seal coat is made by pressure distributor at rate of ⅓ gal. per square yard.

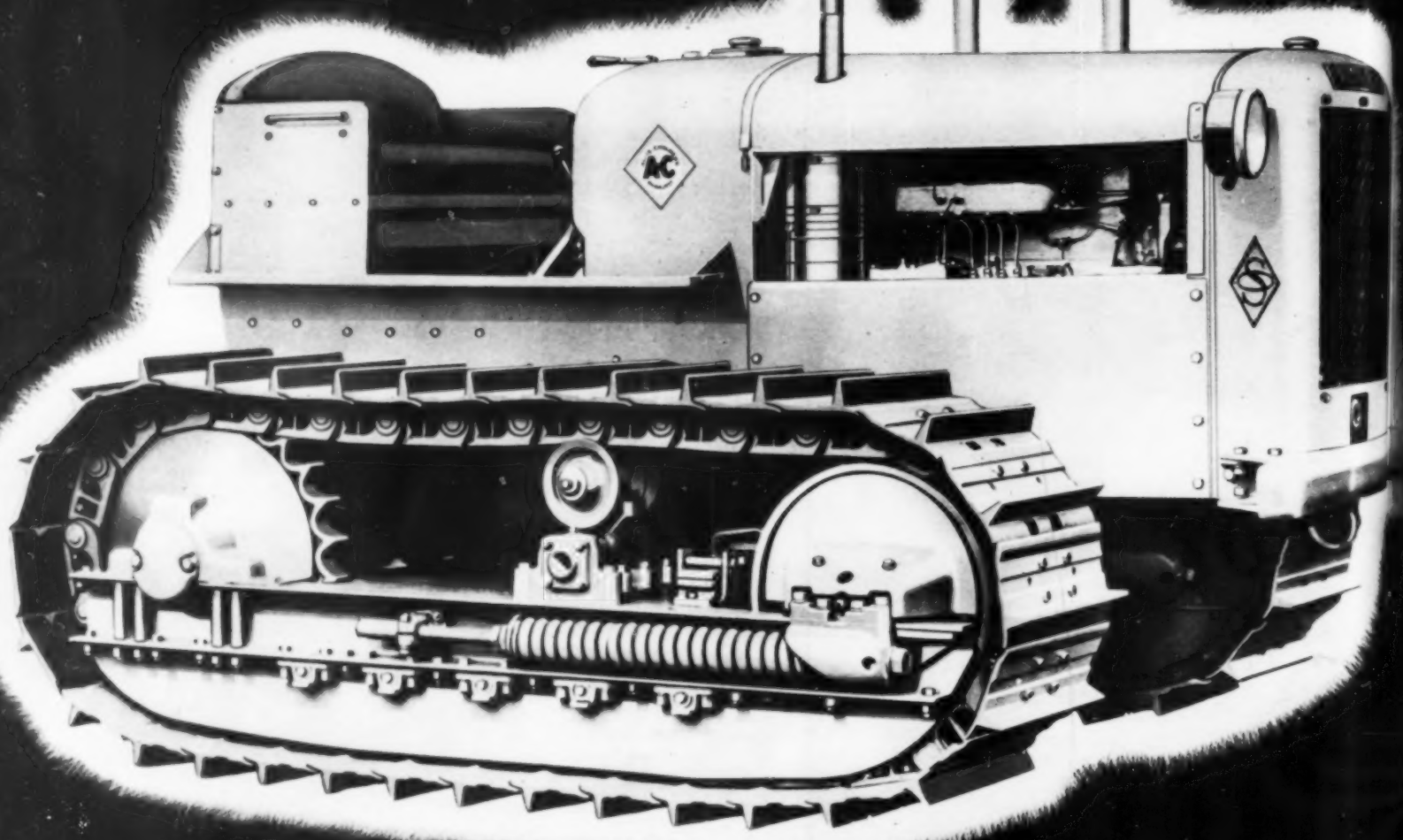
**11** COVERING of final seal coat *(below)* consists of 10 to 15 lb. per square yard of No. 5-B modified aggregate.

**8** COVERING FIRST SEAL COAT *(left)* involves spreading No. 5-B modified aggregate from truck at rate of 10-12 lb. per square yard.

**9** ANOTHER ROLLING takes place to press fine aggregate into seal coat.

**12** ROLLING TO FINISH with either three-wheel or tandem unit, completes operation of building tar re-tread surface. Rollers with auxiliary wheel for increased compression have certain advantages for final rolling.

# The New Leade



- CONTROLLED IGNITION
- FIVE SPEEDS FORWARD; ONE REVERSE
- DIESEL FUEL OIL ECONOMY
- CONSTANT MESH TRANSMISSION
- TRUCK-TYPE GEAR SHIFT
- ROLLER BEARING TRACKS
- CONTROLLED TRACK ALIGNMENT
- MORE POWER PER POUND
- INSTANT STARTING
- UP TO 6.37 MILES AN HOUR

PULLS 10-YARD TRACK WAGON...

er

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## CONTROLLED IGNITION OIL TRACTOR

TO MEET THE NEED for a fast, flexible tractor in this particular power class . . . Allis-Chalmers presents the sturdy, fast-stepping Model "S-O." An entirely new tractor—new engine, new transmission, new tracks—all designed to work together; all built to fit the job. Handles 7 to 8-yard scrapers, 12-foot blade grader or 10-yard track wagon. New Constant-Mesh Transmission—you shift gears with the tractor in motion. Five speeds forward—up to 6.37 miles an hour. Operates on low cost Diesel fuel oil—with the exclusive A-C advantage of Controlled Ignition—one of the greatest tractor improvements in years. The "S-O" brings a new kind of tractor performance to its size and price class.

N...

OR 12-FOOT ALLIS-CHALMERS BLADE GRADER

HANDLES 7 TO 8-YARD SCRAPERS

ILLIS-CHALMERS

TRACTOR DIVISION—MILWAUKEE, U. S. A.

*Controlled Ignition* OIL TRACTORS

# LABOR AND MATERIAL *Costs*

## on Four Highway Jobs

ACCOMPANYING TABLES present actual costs of construction work on four recently completed highway contracts in a Mid-Western state. The contracts involved four different kinds of work: (1) Reinforced concrete pavement, (2) a combination of concrete pavement and bituminous macadam pavement, (3) mixed-in-place bituminous wearing course on waterbound base, and (4) a small reinforced-concrete arch. It must be emphasized that these costs refer to specific contracts executed under conditions peculiar to individual localities. They are of value only as indices of labor and material costs for different types of construction. Under no conditions can they be applied successfully to the estimating of costs on similar construction without due allowance for all local factors.

*Contract No. 1* — Reinforced concrete pavement 36 ft. wide and slightly less than 7/8 mi. in length on a street in a small city was bid in at $51,778.96 and was completed for $52,121.56. The contractor planned to remove the existing pavement and do the grading with a power shovel, six 1½-ton trucks and a tractor and grader, lay the sewer and place a 20-ft. center strip of concrete pavement, followed by the side strips. He had available a five-bag paver, 4½-ton roller, road forms, water pump and small grader. Hauling was to be done with ten 1½-ton trucks.

Required employment on this contract was 30,000 man-hours. The work actually took almost 69,000 man-hours. Maximum hours for manual labor were 8 per day and 130 per month. Specified minimum wage rates were: Skilled, 54c.; intermediate, 43c.; and unskilled, 37½c.

*Contract No. 2* — Reinforced concrete pavement and bituminous macad-

CONTRACT 4 calls for reinforced-concrete arch *(right)* with clear span of 30 ft., rise of 7 ft. and overall width of 32½ ft.

CONTRACT 1 is built by paving mixer which lays 20-ft. center strip before placing 8-ft. side lanes on city street.

CONTRACT 2 utilizes paving mixer to place 20-ft. width of concrete, followed by construction of bituminous macadam lanes on both edges.

### Contract 1 . . . Reinforced Concrete Pavement

LABOR COSTS

| *Classification* | *Man-Hours* | *Wages* |
|---|---|---|
| Executive, Administrative, and Supervisory | 19,294½ | $13,592.83 |
| Skilled | 6,314 | 4,272.87 |
| Intermediate | 19,285¼ | 8,422.74 |
| Unskilled | 23,723¾ | 8,909.63 |
| Total | 68,617½ | $35,198.07 |

MATERIAL COSTS

| *Materials* | *Quantity* | *Total Cost* |
|---|---|---|
| Portland cement, bbl. | 6,512 | $12,590.00 |
| Tar products, gal. | 50 | 7.50 |
| Gravel, tons | 4,429 | 4,429.00 |
| Sand, tons | 2,570 | 2,475.00 |
| Brick, 1,000 | 35 | 455.00 |
| Reinforcing steel, lb. | 76,167 | 2,400.00 |
| Lumber, 1,000 ft. b.m. | 3 | 120.00 |
| Concrete culvert pipe, ft. | 2,317 | 980.00 |
| Motor fuel | | 350.00 |
| Miscellaneous | | 3,194.00 |
| Total | | $27,000.50 |

CONTRACT PRICES

| *Item* | *Quantity* | *Unit Price* | *Amount* |
|---|---|---|---|
| Special fill material | 70 cu.yd. | .90 | $ 63.00 |
| Concrete for structures | 0.3 cu.yd. | 30.00 | 9.00 |
| Brick catch basin and inlet-curb and gutter type | 12 each | 100.00 | 1,200.00 |
| Brick catch basin and inlet-flat top grate | 1 each | 100.00 | 100.00 |
| Inlets adjusted to grade | 1 each | 10.00 | 10.00 |
| Manholes | 5 each | 100.00 | 500.00 |
| Manhole covers adjusted to grade | 5 each | 7.00 | 35.00 |
| Integral curb | 8,452 lin.ft. | .50 | 4,226.00 |
| Curb removal | 2,302 lin.ft. | .15 | 345.30 |
| Combined curb and gutter removal | 4,480 lin.ft. | .15 | 672.00 |
| Sidewalk | 226 sq.yd. | 1.50 | 339.00 |
| Sidewalk removal | 369 sq.yd. | .15 | 55.35 |
| Expansion joint | 2,310 lin.ft. | .70 | 1,617.00 |
| Contraction joint | 2,278 lin.ft. | .17 | 387.26 |
| Pavement removal | 17,474 sq.yd. | .25 | 4,368.50 |
| Brick inlet-curb and gutter type | 10 each | 40.00 | 400.00 |
| Catch basin cover adjusted to grade | 1 each | 7.00 | 7.00 |
| Expansion joint—1-in. cork or rubber | 1,337 lin.ft. | .40 | 534.80 |
| Expansion joint—1-in. preformed | 473 lin.ft. | .25 | 118.25 |
| V.C. pipe 10-in. | 18 lin.ft. | 1.10 | 19.80 |
| V.C. pipe 12-in. | 2,324 lin.ft. | 1.10 | 2,556.40 |
| Reinforced concrete pavement | 19,727 sq.yd. | 1.70 | 33,535.90 |
| Reinf. conc. pavement—high early strength | 333 sq.yd. | 2.00 | 666.00 |
| Reinforcing steel for pavement | 268 lb. | .05 | 13.40 |
| Total | | | $51,778.96 |

### Contract 2 . . . Reinforced-Concrete and Bituminous Macadam Pavement

LABOR COSTS

| *Classification* | *Man-Hours* | *Wages* |
|---|---|---|
| Executive, Administrative, and Supervisory | 8,951 | $ 4,464.20 |
| Skilled | 3,501½ | 4,707.19 |
| Intermediate | 2,972¼ | 2,516.95 |
| Unskilled | 31,592¼ | 16,497.99 |
| Total | 47,017 | $28,186.33 |

am pavement on more than 1.9 mi. of street inside the limits of an industrial city went to the contractor at a bid price of $72,388.83. Reduction in quantities lowered this figure in the actual construction, but $6,520.90 of extra work brought the total cost of the completed project to $73,285.76. The contractor used ordinary equipment in building the pavement.

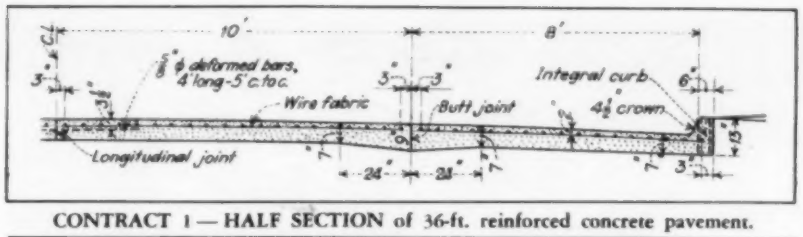
Required employment was 36,500 man-hours; actual employment on the job amounted to more than 47,000 man-hours. Manual labor was permitted to work 8 hr. a day and 130 hr. a month. Because the project was in unionized territory, specified minimum wage rates did not apply. The contractor had to make an agreement with local unions. Specified minimum wage rates were: Skilled 66c.; intermediate, 50c.; and unskilled, 42½c.

*Contract No. 3* — Mixed-in-place bituminous wearing surface, on a waterbound base, involving a 20-ft. road almost 0.7 mi. in length on a grade calling for more than 4,000 yd. of common excavation and borrow, was bid in at $14,476.15 and built for $15,678.52. The contractor planned to build the grade with tractors, wheel scrapers, blade machines and rollers. For the hauling he had available ten 5-ton trucks.

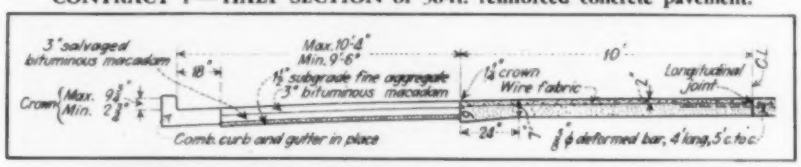
Required employment was 7,400 man-hours; actual employment totalled almost 10,000 man-hours. Maximum hours permitted for manual labor were 8 per day and 130 per month. Specified minimum wage rates were: Skilled, 49c.; intermediate, 39c.; unskilled, 35c.

*Contract No. 4* — A 30-ft. reinforced-concrete arch on a 30-deg. skew was awarded at a bid price of $7,751.27 and was built for $6,608.27, the actual quantities for some items running less than estimated, as shown in one of the tables. The contractor laid out the work to excavate and fill with a ¼-yd. crane, mix concrete with a two-bag mixer and place the concrete with the crane and hand carts. He had available a roller for compacting fill and three pumps of 2-in. to 4-in. size for unwatering.

Required employment called for by the contract amounted to 4,900 man-hours; actual employment was more than 5,000 man-hours. Maximum hours allowed for manual labor were 8 per day and 130 per month. The contract specified minimum wage rates of 49c. for skilled, 39c. for intermediate and 35c. for unskilled.




CONTRACT 1 — HALF SECTION of 36-ft. reinforced concrete pavement.




CONTRACT 2 — HALF SECTION of combination concrete and bituminous macadam. Macadam shoulders on two sides of pavement are not symmetrical.

(Contract 2—Continued)

### MATERIAL COSTS

| Materials | Quantity | Total Cost |
|---|---|---|
| Portland cement, bbl. | 7,832 | $15,350.72 |
| Asphaltic cement, gal. | 40,000 | 4,000.00 |
| Stone, tons | 8,160.7 | 8,863.26 |
| Sand, tons | 3,454.4 | 2,763.52 |
| Brick, 1,000 | 13.2 | 166.98 |
| Wire mesh reinforcing, lb. | 103,604 | 2,417.35 |
| Lumber, 1,000 ft. b.m. | 14 | 581.62 |
| V.C. culvert pipe, ft. | 2,033 | 850.29 |
| Gasoline, gal. | 8,793 | 1,477.22 |
| Miscellaneous | | 3,117.44 |
| Total | | $39,588.40 |

### CONTRACT PRICES

| Item | Quantity | Unit Price | Amount |
|---|---|---|---|
| Rock asphalt | 40 tons | 30.00 | $ 1,200.00 |
| Reinf. conc. pavement | 23,932 sq.yd. | 2.07 | 49,539.24 |
| Subgrade fine aggregate | 702 cu.yd. | 2.75 | 1,930.50 |
| Salvaged aggregate | 1,405 cu.yd. | 1.25 | 1,756.25 |
| Aggregate | 1,529 cu.yd. | 2.75 | 4,204.75 |
| Bituminous material | 47,222 gal. | .12 | 5,666.44 |
| Bit. material for prime coat | 114 gal. | .20 | 22.80 |
| Expansion joints | 87 lin.ft. | .80 | 69.60 |
| Expansion joints | 2,520 lin.ft. | .80 | 2,016.00 |
| Contraction joints | 2,634 lin.ft. | .20 | 526.80 |
| Concrete for structures | 0.8 cu.yd. | 25.00 | 20.00 |
| Brick catch basins & inlets, curb and gutter type | 4 each | 100.00 | 400.00 |
| Manhole | 2 each | 100.00 | 200.00 |
| Manhole cover adjusted to grade | 1 each | 10.00 | 10.00 |
| Concrete curb | 40 lin.ft. | 1.00 | 40.00 |
| Combined curb and gutter | 509 lin.ft. | 1.00 | 509.00 |
| Combined curb and gutter removal | 477 lin.ft. | .25 | 119.25 |
| Monuments | 3 each | 5.00 | 15.00 |
| Concrete sidewalks | 54 sq.yd. | 2.50 | 135.00 |
| Concrete sidewalk removal | 84 sq.yd. | .20 | 16.80 |
| Pavement removal | 616 sq.yd. | 1.00 | 616.00 |
| Brick inlets, curb and gutter type | 7 each | 40.00 | 280.00 |
| Brick inlet, flat top grate | 1 each | 40.00 | 40.00 |
| Brick catch basin and inlet, flat top grate | 1 each | 100.00 | 100.00 |
| Special concrete gutter | 40 lin.ft. | 1.00 | 40.00 |
| Concrete gutter removal | 31 lin.ft. | .20 | 6.20 |
| Expansion joints, 1-in. cork or rubber | 356 lin.ft. | .60 | 213.60 |
| Expansion joints, 1-in. preformed | 127 lin.ft. | .25 | 31.75 |
| Expansion joints, ½-in., preformed bituminous | 299 lin.ft. | .15 | 44.85 |
| Brick collars for pipe | 43 each | 15.00 | 645.00 |
| Sewer pipe, concrete 10-in. | 20 lin.ft. | .90 | 18.00 |
| Reinf. concrete pipe 12-in. | 1,778 lin.ft. | 1.10 | 1,955.80 |
| Total | | | $72,388.83 |

## Contract 3 . . . Mixed-in-Place Bituminous Surface on Waterbound base

### LABOR COSTS

| Classification | Man-Hours | Wages |
|---|---|---|
| Executive, Administrative, and Supervisory | 2,060 | $1,270.00 |
| Skilled | 93¾ | 65.82 |
| Intermediate | 3,982¼ | 2,058.92 |
| Unskilled | 3,850¼ | 1,348.11 |
| Total | 9,986¼ | $4,742.85 |

### MATERIAL COSTS

| Materials | Quantity | Total Cost |
|---|---|---|
| Portland cement, bbl. | 18 | $ 36.00 |
| Asphaltic cement, gal. | 14,509 | 870.54 |
| Tar products, gal. | 3,840 | 384.00 |
| Stone, cu.yd. | 3,165 | 5,538.75 |
| Sand, cu.yd. | 15 | 37.50 |
| Metal culvert pipe, ft. | 306 | 212.22 |
| Motor fuel, gal. | 6,600 | 268.80 |
| V.C. pipe, ft. | 374 | 68.66 |
| Total | | $7,416.47 |

BITUMINOUS MATERIAL on Contract 2 is applied to macadam of irregular width by hand-held spray.

(Contract 3—Continued)

### CONTRACT PRICES

| Item | Quantity | Unit Price | Amount |
|---|---|---|---|
| Excavation—common | 2,604 cu.yd. | .40 | $1,041.60 |
| Excavation—special borrow | 1,516 cu.yd. | .50 | 758.00 |
| Concrete for structure | 2.2 cu.yd. | 23.00 | 50.60 |
| Rubble head walls | 11.7 cu.yd. | 10.00 | 117.00 |
| Concrete catch basins and inlets, earth ditch type | 3 each | 80.00 | 240.00 |
| Special 12-in. V.C. pipe inlets | 2 each | 25.00 | 50.00 |
| Crushed stone or gravel | 63 tons | 2.50 | 157.50 |
| Aggregate for shoulder drains | 6 tons | 5.00 | 30.00 |
| Sewer pipe V.C. 8-in. | 120 lin.ft. | .60 | 72.00 |
| Pipe-corrugated metal 12-in. | 146 lin.ft. | 1.10 | 160.60 |
| Pipe V.C. 12-in. | 20 lin.ft. | 1.10 | 22.00 |
| Drain tile 12-in. | 156 lin.ft. | .80 | 124.80 |
| Pipe-corrugated metal 15-in. | 92 lin.ft. | 1.25 | 115.00 |
| Pipe-corrugated metal 24-in. | 52 lin.ft. | 2.50 | 130.00 |
| Coarse aggregate for waterbound base | 1,245 tons | 2.50 | 3,112.50 |
| Screenings for waterbound base | 374 tons | 2.50 | 935.00 |
| Subgrade fine aggregate | 299 cu.yd. | 3.00 | 897.00 |
| Bit. material for prime | 4,800 gal. | .15 | 720.00 |
| Aggregate for mixed-in-place surface | 1,441 tons | 2.50 | 3,602.50 |
| Bit. material for mixed-in-place top | 14,267 gal. | .15 | 2,140.05 |
| Total | | | $14,476.15 |

## Contract 4 . . . Reinforced-Concrete Arch

### LABOR COSTS

| Classification | Man-Hours | Wages |
|---|---|---|
| Executive, Administrative, and Supervisory | 1,238 | $ 497.46 |
| Skilled | 562 | 390.60 |
| Intermediate | 1,322 | 587.94 |
| Unskilled | 1,893½ | 662.88 |
| Total | 5,015½ | $2,138.88 |

### MATERIAL COSTS

| Materials | Quantity | Total Cost |
|---|---|---|
| Portland cement, bbl. | 282 | $ 606.30 |
| Gravel, cu.yd. | 183.6 | 302.94 |
| Sand, cu.yd. | 102 | 153.00 |
| Reinforcing steel, lb. | 10,418 | 291.70 |
| Lumber, 1,000 ft. b.m. | 20.527 | 533.49 |
| Motor fuel, gal. | 2,335 | 413.19 |
| Miscellaneous | | 1,213.36 |
| Total | | $3,513.98 |

### CONTRACT PRICES

| Item | Quantity | Unit Price | Amount |
|---|---|---|---|
| Concrete | 52 cu.yd. | 20.00 | $1,040.00 |
| Concrete above footings | 84 cu.yd. | 20.00 | 1,680.00 |
| Concrete in footings | 68 cu.yd. | 20.00 | 1,360.00 |
| Wet excavation | 289 cu.yd. | 3.50 | 1,011.50 |
| Dry excavation | 25 cu.yd. | .60 | 15.00 |
| Excavation for clearing waterway and channel change | 1,490 cu.yd. | .50 | 745.00 |
| Special borrow | 1,190 cu.yd. | .30 | 357.00 |
| Handrail | 66.33 lin.ft. | 3.50 | 232.15 |
| Reinforcing steel | 10,418 lb. | .04 | 416.72 |
| Special filling material | 692 cu.yd. | .75 | 519.00 |
| Cast iron | 151 lb. | .10 | 15.10 |
| Gravel or crushed stone surface | 452 sq.yd. | .40 | 180.80 |
| Flexible steel plate guard rail | 179 lin.ft. | 1.00 | 179.00 |
| Total | | | $7,751.27 |
| *Underruns* | | | |
| Wet excavation | 5 cu.yd. | 3.50 | 17.50 |
| Excavation for clearing waterway and channel change | 136 cu.yd. | 0.50 | 68.00 |
| Special borrow | 1,051 cu.yd. | 0.30 | 315.30 |
| Special filling material | 246 cu.yd. | 0.75 | 184.50 |
| Gravel or crushed stone surface | 452 sq.yd. | 0.40 | 180.80 |
| Flexible steel-plate guard rail | 179 lin.ft. | 1.00 | 179.00 |
| Total (Underruns) | | | $945.10 |
| *Overruns* | | | |
| Dry excavation | 6 cu.yd. | 0.60 | 3.60 |

J. A. McCARTHY, senior civil engineer, in charge of $8,000,000 sidewalk construction program for Massachusetts Dept. of Public Works.

HAND LABOR is used almost exclusively in placing and rolling the bituminous sidewalk alongside granite curb.

ROBERT E. PYNE, principal assistant to J. A. McCarthy, on Massachusetts sidewalk program.

## 500-Mile Program of

# Bituminous Sidewalks

## Employs 12,000 Jobless in Massachusetts

A THREE-FOLD objective has been attained by the statewide program of constructing 500 mi. of sidewalks along Massachusetts highways which the Commonwealth's Department of Public Works, under Commissioner William F. Callahan and George H. Delano, chief engineer, has been carrying on for the past year with local day labor and with WPA personnel: First, the spending of federal and state funds aggregating $8,000,000 (a $4,000,000 state bond issue supplemented by an allocation of $4,000,000 of federal relief funds from WPA) has been effective in providing employment for about 12,000 men on a type of work ideally suited to unskilled labor in need of employment. Second, by removing pedestrians from the state highways, the sidewalk construction will make a substantial reduction in the number of injuries and deaths of persons on foot struck by motor vehicles. Third, an indirect effect of the sidewalk program is manifesting itself in the increase in the value of property abutting on state routes where improvements have been made.

All of the sidewalk work is being done by direct labor; no contracts are involved except for supplying the granite curbing and the bituminous surfacing material which are called for in the standard designs for the sidewalks. The improvements also are limited to state routes; no local roads are included in the program. Property owners, it has been found, have been glad to cooperate with the Department of Public Works by offering easements for sidewalks without compensation.

*Pedestrian Accidents Studied* — As a basis for determining where the sidewalks should be built in order to be most effective as a traffic safety measure an analysis of pedestrian-motor vehicle accidents was made covering the entire state for the 6-year period, 1930-1935, inclusive. The recorded number of pedestrian accidents in Massachusetts, totaling 4,427, are listed in the accompanying table, which shows a progressive increase for five years in the number of both injuries and deaths:

**Pedestrian-Motor Vehicle Accidents in Massachusetts**

| Year | Persons Injured | Persons Killed |
|---|---|---|
| 1930 | 492 | 67 |
| 1931 | 568 | 86 |
| 1932 | 638 | 99 |
| 1933 | 720 | 96 |
| 1934 | 717 | 133 |
| 1935 | 706 | 105 |
| Total | 3,841 | 586 |

The general trend has been toward an increase in pedestrian accidents in rural communities and a decrease within the limits of larger cities.

On a road map of Massachusetts the location of each pedestrian accident was plotted to present a graphic picture of the danger spots which sidewalk construction could be counted upon to eliminate. Another consideration in deciding upon locations for sidewalk construction along state highways was the number of local petitions received by the Department of Public Works for this type of improvement. Also, the amount of unemployment in various localities had an influence in allocating the sidewalk projects to specific sections of the state.

*Design* — The accompanying drawing indicates the general features of the design of the sidewalks which Massachusetts is building. Widths vary from 3½ ft., in rural locations, to 7 ft. in built-up urban sections where streets are flanked with stores and office buildings. As a rough general average a sidewalk width of 4 to 4½ ft. prevails. The surfacing adopted for all but a few locations is a plant-mixed bituminous concrete, laid both hot and cold, although the hot mix is preferred. This mix is comparatively low in cost and presents no particular difficulties in placement and finishing by unskilled labor under proper supervision, an important consideration inasmuch as the ranks of the construction personnel on the sidewalk program had to be recruited largely from relief rolls. Usually, the sidewalks are built along only one side of a state highway, although in certain special cases both sides of the road are provided with walks.

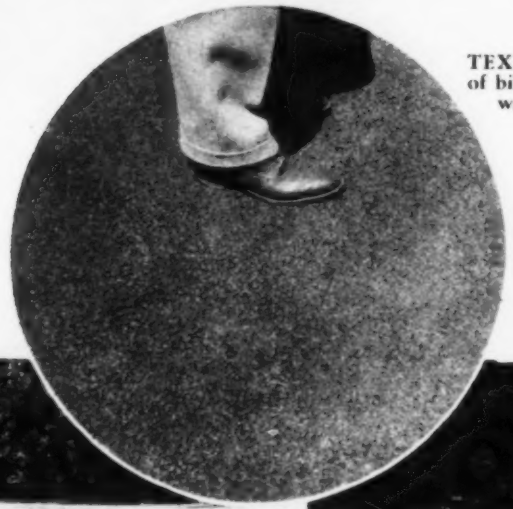
The specifications require, first, a compacted gravel base 6 in. thick to support and drain the bituminous top. The bituminous surfacing, 2 in. thick, is laid in two courses, a bottom or binder course of 1¼ in., and a top course of ¾ in.

*Bituminous Mix* — The mix for the binder course contains from 4 to 6 per cent of bitumen and the following percentages of mineral aggregate passing or retained on square-mesh sieves of the sizes indicated: 90-100 per cent passing ¾ in.; 58-80 per cent passing ¾-in. and retained on No. 10 sieve; 16-36 per cent passing No. 10 sieve.

For the top or wearing course the mix contains 4.5 to 8.5 per cent of bitumen and mineral aggregate as follows: 100 per cent passing ½-in. sieve; 10-40 per cent passing ½-in. and retained on ¼-in.; 38-70 per cent passing ¼-in. and retained on No. 10; 4-20 per cent passing No. 10 and retained on No. 20; 3-15 per cent passing No. 20 and retained on No. 40; 3-15 per cent passing No. 40 and retained on No. 80; 2-15 per cent pass-

GRAVEL BASE, 6-in. thick, is placed and compacted to support and drain sidewalk surfacing.

**GRANITE CURB** flanks sidewalks. **SLOPING FACE TYPE** of curb *(at left)* is most largely used. **MOTOR TRUCK** *(above)* delivers curbing to place. **VERTICAL FACE TYPE** of curb *(right)* is alternative design.



**TEXTURE** *(left)* of bituminous sidewalk surface.

ing No. 80 and retained on No. 200; 4-6 per cent passing No. 200.

A 10-mesh sieve marks the dividing line between what is considered coarse and fine mineral aggregate. In the case of the mix for sidewalk top surfacing the permissible range for coarse aggregate material is from 50 to 70 per cent.

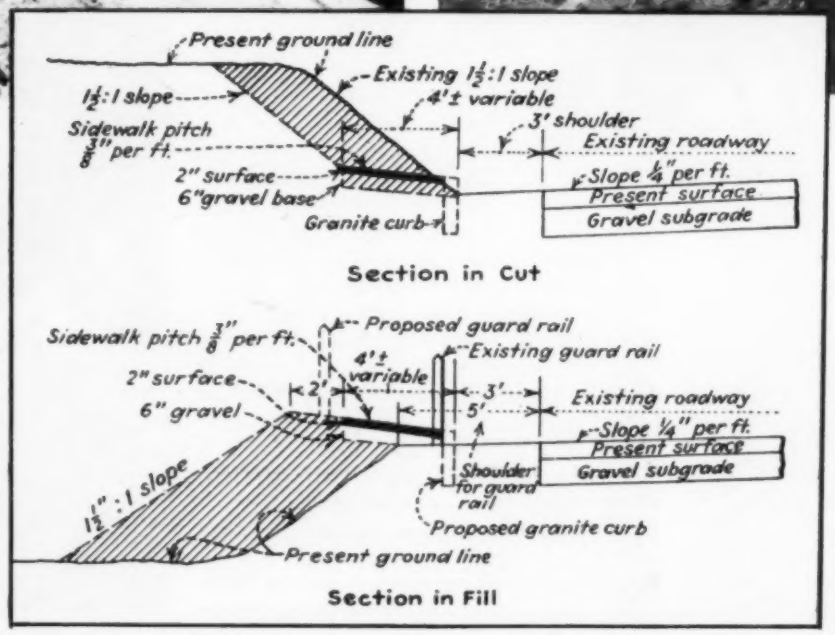
The several composition limits given above are master ranges of tolerance to govern mixtures of raw materials and are maximum and minimum for all cases. A closer control within these limits is intended for each specific project. On the regular work of the state the fine asphaltic concrete top surface mix, designated as Type E, is used ordinarily to repair pavement holes not more than 2 in. deep, for skin patching and bringing pavement surface to proper contour and grade.

For the coarse mineral aggregate — considered to be that portion retained on a 10-mesh sieve — the French coefficient of wear must be not less than 14 and the toughness not less than 12. The fine mineral aggregate — passing a 10-mesh sieve — may be sand or stone screenings. Mineral filler is cement or limestone dust, completely passing a 30-mesh sieve and at least 75 per cent passing a 200-mesh sieve. Plant mixing is required for both top and binder courses.

*Granite Curb* — All sidewalk surfaces are laid with a lateral pitch of ⅜ in. per foot for drainage toward the main highway. Where cuts or fills are necessary their side slopes are 1 on 1½. For a large part of the program the sidewalk edge is finished with a granite curb having either a vertical or a sloping face. All sidewalks are built back of the highway location line so that they may be preserved in the event of any future widening of the road. Where highway guard rail is required

**SIDE-HILL CUTS** are sometimes required to provide sidewalk location along highways.

**DRIVEWAYS** are built between highways and garages of property along new sidewalks.




**CROSS-SECTION** of typical sidewalk design in cut and on fill.

SEEDED STRIP is sometimes interposed between granite curb and sidewalk edge.

it is set outside the sidewalk line. In certain places 3-ft. wide grass strips are interposed between the strip of bituminous sidewalk surface and the granite curbing.

As shown in the sketch herewith the design calls for a granite curb along the sidewalk. These curbs retain the gravel base for the sidewalks, reduce the cost of shoulder maintenance on the highway proper and, by their grayish white color, aid in guiding traffic away from the pavement edge during night driving. The granite curbs also give the improvement a neat, finished appearance. Massachusetts contains several quarries and the specification of granite curbing for a considerable mileage of sidewalk insured jobs at the quarries during a period of 6 to 7 months for nearly 500 granite workers who might otherwise have been idle. About 85 per cent of the cost of quarrying the granite curbing is for direct labor. To date, a total of about 250 mi. of curbing along sidewalks has been installed.

Several types of granite curb are specified for different urban and rural conditions, all types being supported in place on a 4-in. gravel base and having portland cement mortar joints. In all, there are four types of vertical-face curb and three types of sloping-face curb. For the vertical face types specified lengths range from 6 ft. to 1 ft., depths from 19 in. to 14 in., top widths from 7 to 3 in., and bottom widths from 4 in. to 2 in. For the sloping-faced curbing lengths range from 6 ft. to 1 ft., depths from 11 to 13 in., and widths from 8 to 3 in.

GUARD RAIL is built beyond outer edge of sidewalk.

MECHANICAL EQUIPMENT, in form of light powered roller, is used occasionally.

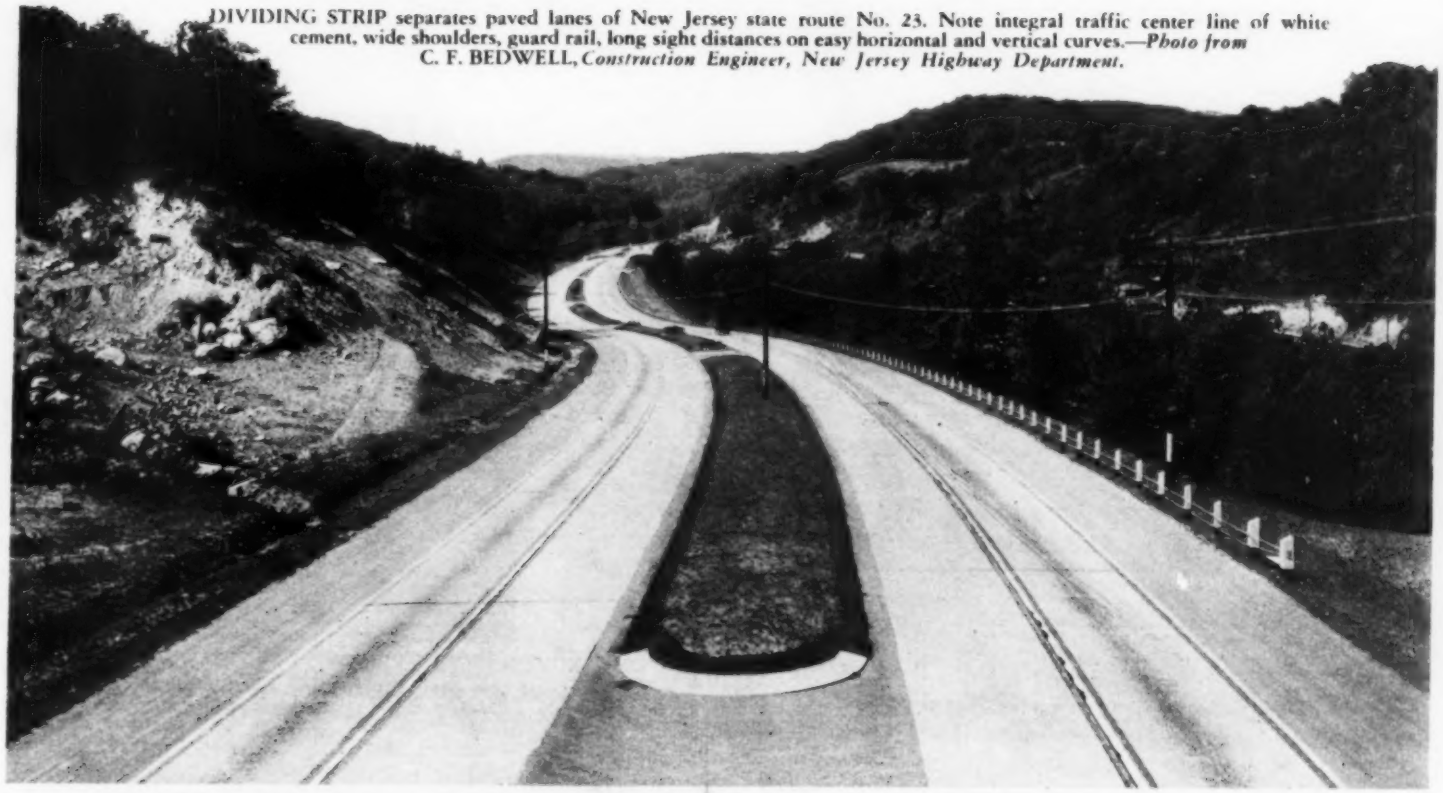
INCLINED CURB embodies safety feature, causing less damage to motor vehicles striking it than vertical face type of curb.

The deeper, vertical-faced curbing is used mainly within city limits. The curb most largely used in rural locations is the sloping-face, Type C, having limits of 1 to 6 ft. in length, 11 to 13 in. in depth and 3 to 6 in. in thickness. An advantage claimed for the curb with sloping face — laid at an angle of about 45 deg. with the horizontal — is that a vehicle striking it rides up over the curb while impact with a vertical face may cause damage.

*Labor and Supervision* — For building the sidewalks labor is recruited from local relief rolls and from WPA workers, all under the supervision of engineers of the Massachusetts Department of Public Works reporting to J. A. McCarthy, senior civil engineer, whose principal assistant is Robert E. Pyne. Employment has been given to about 4,500 local day labor men on payrolls of the state and to 7,500 WPA workers receiving Federal funds. Hours of work are limited to 100 per month for the WPA personnel and to 40 per week for labor employed directly by the state department.

*Construction* — Methods and equipment for building the sidewalks, as illustrated in the accompanying photographs, are simple from the construction point of view and are well suited to unskilled labor. Grading is done for the most part with hand tools, except where rock cuts require air drills and portable compressors. Usually hand rollers are employed to compact both the gravel base and the bituminous concrete top, but occasionally light power rollers are employed. The hand rollers range in weight from a 350-500 lb. water-filled cylinder up to 1,000-lb. units. The bituminous base and top course mixes are delivered by truck and spread by hand. The department's engineers have used both a cold mix and a hot mix and prefer the latter for sidewalk construction.

FINISHED SIDEWALK showing bituminous top surface and vertical faced granite curb.



DIVIDING STRIP separates paved lanes of New Jersey state route No. 23. Note integral traffic center line of white cement, wide shoulders, guard rail, long sight distances on easy horizontal and vertical curves.—*Photo from* C. F. BEDWELL, *Construction Engineer, New Jersey Highway Department.*

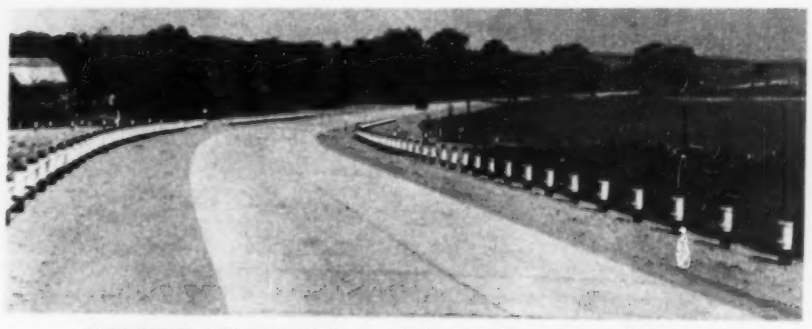
# *HIGHWAYS with SAFETY*

# "BUILT IN"

**Examples of what the states are doing to reduce motor vehicle accidents by improved design and construction of roads. "Built-in" safety for roads and streets will be a major topic of discussion at the forthcoming annual convention in New Orleans, Jan. 11-18, of the American Road Builders' Association.**

ILLUMINATION for night driving on route south of Tacoma, Wash., is accomplished by installation of non-glare sodium vapor lights on 3-mi. section, especially advantageous during heavy fogs. Note 4-ft. wide neutral zone marked by dual traffic lines along center of pavement..— *Photo,* L. V. MURROW, *Director of Highways, State of Washington.*

WIDE ROADBED on Texas route near San Antonio is flanked by broad caliche shoulders. Highway of modern design has long sight distances with no traffic-way restrictions or culvert hazards. — *Photo from* GIBB GILCHRIST, *State Highway Engineer of Texas.*



SUPERELEVATED CURVES are built into Durand cutoff. Michigan highway has wide shoulders, long sight distances and guard rail protection. — *Photo,* H. C. COONS, *Chief Engineer, Michigan Highway Department.*

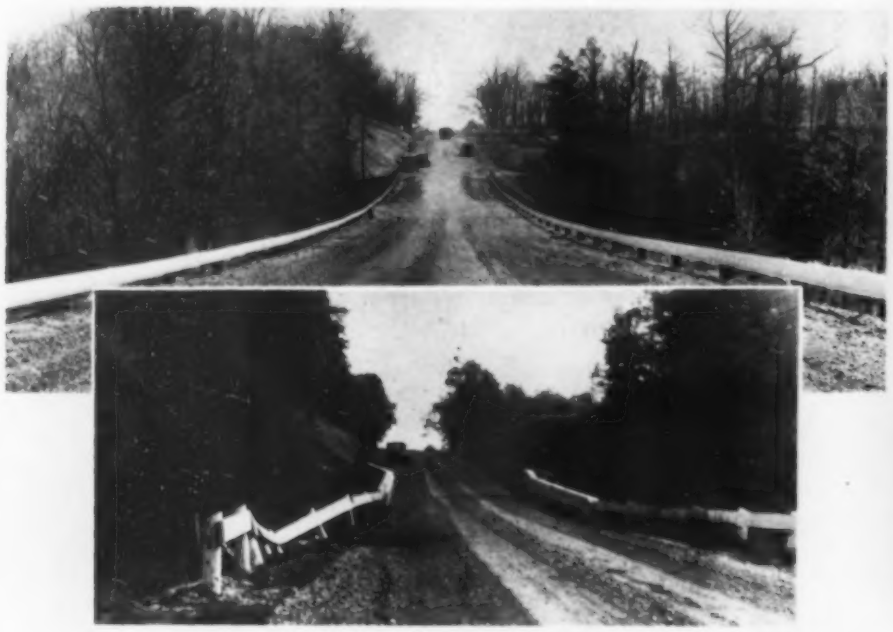
*(Continued)*

# *HIGHWAYS with*

RAILROAD GRADE SEPARATION built with federal funds near Caldwell, Texas. — *Photo, U. S. Bureau of Public Roads.*

BUILT-UP SUPERELEVATION on curves of old bituminous route in Tennessee where original construction was flat. Guard rail is of wide metal-band type. — *Photo from* E. M. TURNER, *Assistant State Highway Engineer of Tennessee.*

GRADE SEPARATION on Boston-Worcester Turnpike, Massachusetts, showing design for eliminating left turns in entering or leaving main route. — *Photo, U. S. Bureau of Public Roads.*



ROAD WIDENING in Indiana, with arch culvert installed to eliminate bottleneck on old route. Before-and-after views indicate improvement, with new guard rail. — *Photo from* SULTAN G. COHEN, *Engineer of Construction, Indiana Highway Department.*

PEDESTRIAN UNDERPASS and bridle path provide safe means of crossing Grand Central Parkway, Long Island, N. Y. — *Photo from* DAVID NOONAN, *Assistant Commissioner New York Division of Highways.*

# *SAFETY* "BUILT IN"

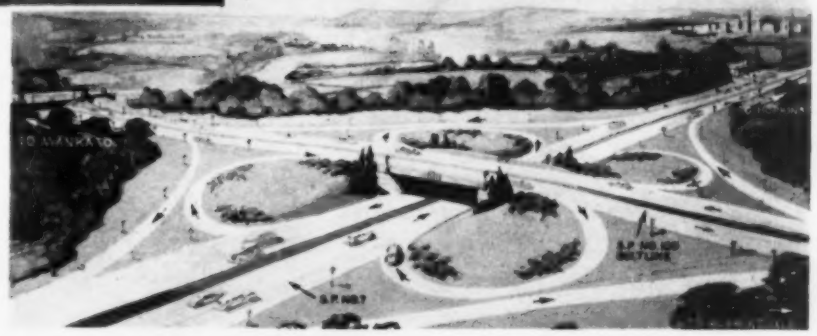
GENTLE SLOPES of road shoulder and side ditches add to safety and general appearance of this 20-ft. wide bituminous road near Lancaster, Pa. — *Photo, U. S. Bureau of Public Roads.*

ALTERNATE LIGHT AND DARK lanes, supplemented by white traffic line markers, increase safety of Nassau Boulevard extension, Long Island, N. Y. — *Photo from* DAVID NOONAN, *Assistant Commissioner, New York Division of Highways.*

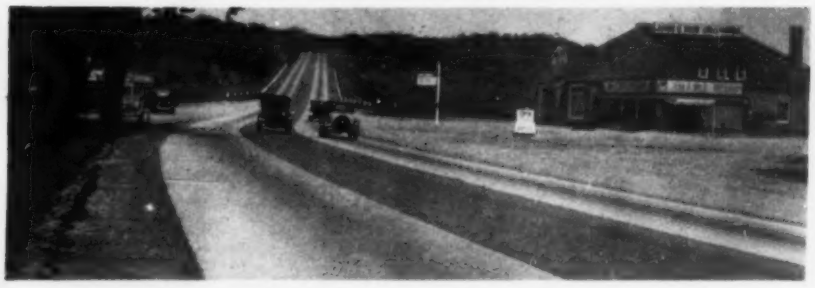
GRADE CROSSING ELIMINATION and entrance and exit drives eliminating left turns are safety features of Sunrise Highway in Suffolk County, N. Y.

BITUMINOUS SURFACED SIDEWALKS keep pedestrians off trunk highways and help to minimize accidents.

ROAD RELOCATION in South Dakota, showing before-and-after conditions where danger spot with sharp curvature *(in inset)* was eliminated by smoothing out line of route and installing bridge over railroad track. — *Photo from* F. H. SCHRADER, *State Highway Engineer of South Dakota.*



CLOVER LEAF INTERSECTION is designed to minimize accidents on Minnesota route leading to Minneapolis. — *Photo from* O. L. KIPP, *Construction Engineer, Minnesota Highway Department.*



WIDENING of Massachusetts route near Marlboro provides three-lane highway with bituminous center strip and concrete outer lanes flanked by hardened shoulders. Original road had only two lanes. *Photo, U. S. Bureau of Public Roads.*

# Illinois Concrete Paving Job Tests Utility of VIBRATORY FINISHER

FIVE PUDDLERS spread dumped batches of harsh concrete against edge forms and joints ahead of vibratory finisher.

TYPICAL CONCRETE PAVING JOB in Illinois uses vibratory finishing machine on 9-6½-9-in. slab 20 ft. wide. Center-line plates and transverse joints are set some distance ahead of paver, which travels on shoulder.

FIELD OPERATIONS are directed for contractor by Rodney L. Bell (left) and for Illinois Division of Highways by L. E. Leka, testing engineer, Bureau of Materials.

MIXER INSPECTION is responsibility of Carl Royer (in cap), backed up by an able assistant.

ON A TYPICAL contract job selected by the Illinois Division of Highways in cooperation with the Bureau of Public Roads to test the practicability of using a vibratory finishing machine in concrete pavement construction, R. P. Devine, of Watseka, Ill., contractor, last fall maintained steady progress of about 112 lin. ft. an hour while laying 5 mi. of 9-6½-9-in. slab 20 ft. wide on a connecting link between state routes 125 and 123 several miles west of Springfield. Fulfilling the expectations of highway engineers who planned the project, the contractor built the road with normal equipment and methods and without any enlargement of his ordinary construction force, placing and finishing several different concrete mixtures in the course of the job without any slackening of progress. The efficiency of the work was aided by the design of the mixtures, which were proportioned to fit the placing methods.

Illinois highway engineers, particularly those in the Bureau of Materials, had received an intensive education in the vibration of concrete pavement in 1932, when they built a mile of experimental road incorporating 114 test sections designed to determine the maximum practical limit of a vibratory finishing machine in placing dry, oversanded and overstoned mixtures. An ancestor of the vibratory finishing machine used on the 1936 contract served in the earlier experimental work. Following completion of the experimental project, vibratory finishing went into temporary eclipse in Illinois until 1936, when contractors were invited to bid on the 5½-mi. project awarded to R. P. Devine, the low bidder. For the practical purposes of this project, the Bureau of Materials designed mixtures which would give the best results obtainable in vibratory finishing.

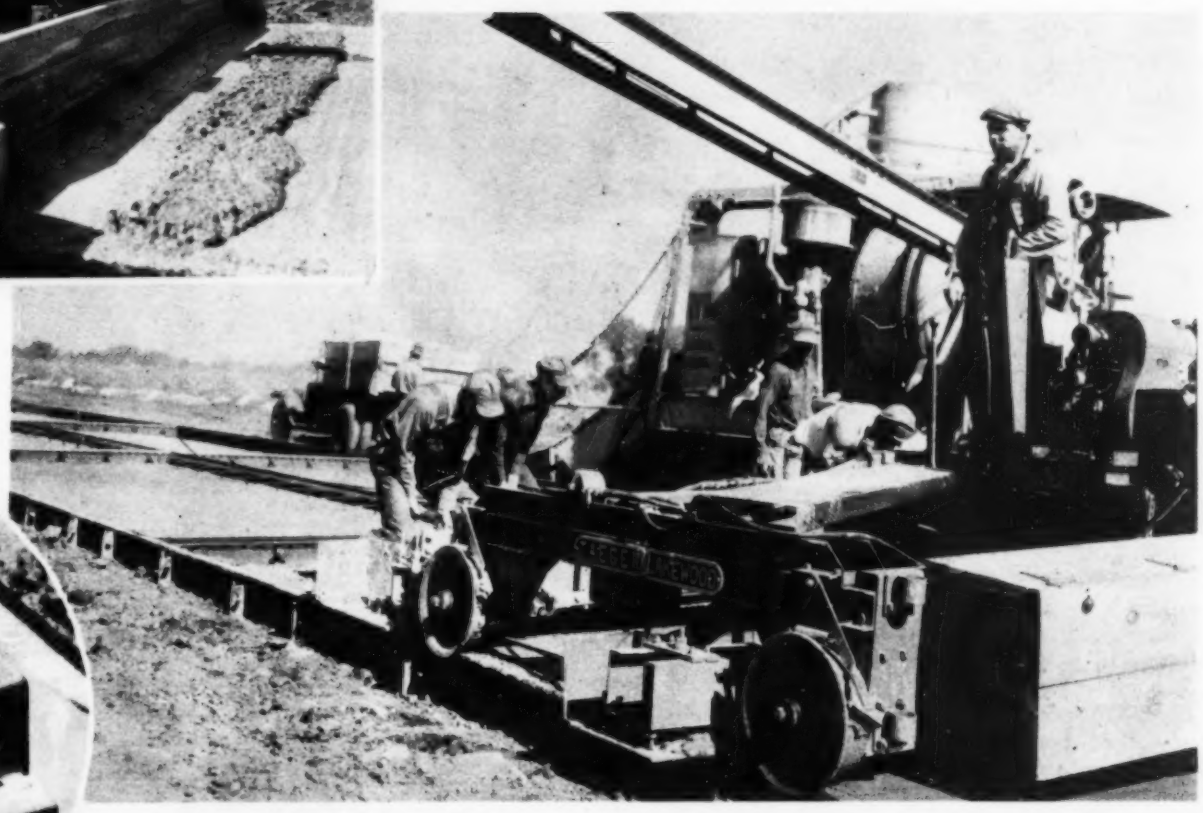
*Vibratory Finishing Machine*—Two

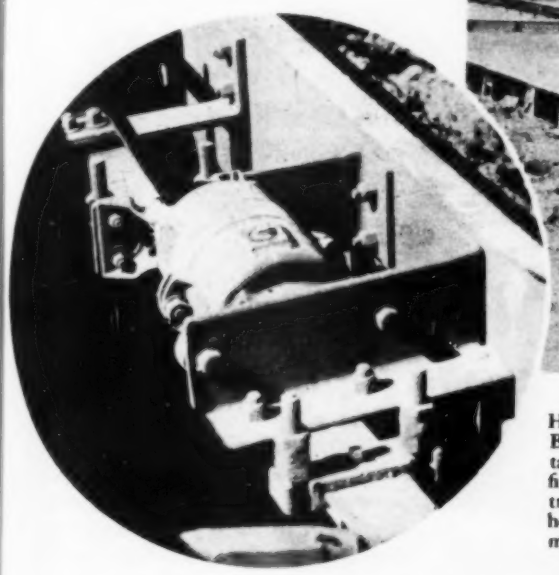
**Contract Prices . . . Major Items**

| Item | Estimated Quantity | Unit Price | Value |
|---|---|---|---|
| Earth excavation, cu. yd. | 85,610 | .34 | $29,107.40 |
| Earth shoulders, sq. yd. | 51,735 | .07 | 3,621.45 |
| Cement, bbl. | 20,861 | 2.04 | 42,556.44 |
| Portland cement concrete pavt., 9-6½-9-in. section, sq. yd. | 63,455 | 1.45 | 92,009.75 |
| Portland cement concrete pavt., 16½-10½-16½-in. section, sq. yd. | 206 | 2.00 | 412.00 |
| Plain concrete gutter, two types, lin. ft. | 18,639 | .50 | 9,319.50 |
| Structural concrete, cu. yd. | 445.9 | 21.50 | 9,586.85 |
| Reinforcement bars, lb. | 45,972 | .04 | 1,838.88 |
| Total Value of Contract | $191,578.77 | | |

ROLLED BULL-NOSE FRONT of vibratory screed serves to crowd additional concrete under bottom plate to provide for increased density obtained by vibration.

RIDING ON STEEL EDGE FORMS *(below)* with 6-in. base 10,700 lb. finishing machine vibrates and strikes off low-slump concrete without causing appreciable form settlement.





HIGH-FREQUENCY VIBRATOR *(in circle)* attached to front screed of finishing machine has electric motor inclosed in same housing with vibrating element. Three vibrators are mounted on screed.

reciprocating screeds were mounted on the finishing machine, a standard self-propelled Jaeger-Lakewood unit designed expressly for vibratory finishing. Vibrating was done entirely with the front screed, to which three Jackson high-frequency electric vibrators were attached. Width of the forward screed was 18 in. as compared with 12 in. for the rear screed, used exclusively for finishing. At the front of the forward screed, the bottom plate was turned up in a curve of 2¼-in. radius to a connection with the vertical plate, forming a rolled bull nose at the surface of the slab which crowded sufficient concrete under the screed to take care of the increased consolidation obtained by vibration.

A gasoline-powered motor-generator set mounted on the finishing machine supplied electric current to the vibrators. The mechanical equipment and some slight additional reinforcement required for the vibratory process increased the weight of the vibratory finishing machine to about 10,700 lb., approximately 1,000 lb. heavier than an ordinary finishing machine not so equipped. On the Devine contract the 10,700-lb. machine operated on forms with a 6-in. base while vibrating concrete having a slump of 1 in. or less. The forms were laid on a sandy loam subgrade and were well tamped, particularly at the joints. Under the load of the vibratory finishing machine, they showed no appreciable settlement.

Frequency of vibrations of the front screed ranged from 3,950 to 4,150 r.p.m. A vibrating reed tachometer used to check the frequency indicated 4,150 r.p.m. with the screed sitting on the forms, not in contact with concrete, and 3,950 to 4,075 r.p.m. when pushing a good load of concrete.

*Concrete Mixtures*—To study the results of vibratory finishing on concrete mixtures containing two different coarse aggregates, half the project was paved with gravel concrete and the remainder with crushed stone concrete. It was desired to learn the effect of vibration (1) on mixtures having the standard yield per bag of cement, and (2) on mixtures having the same strength as standard. Mixtures meeting these specifications and fitting exactly the requirements of vibratory finishing were designed by the Bureau of Materials.

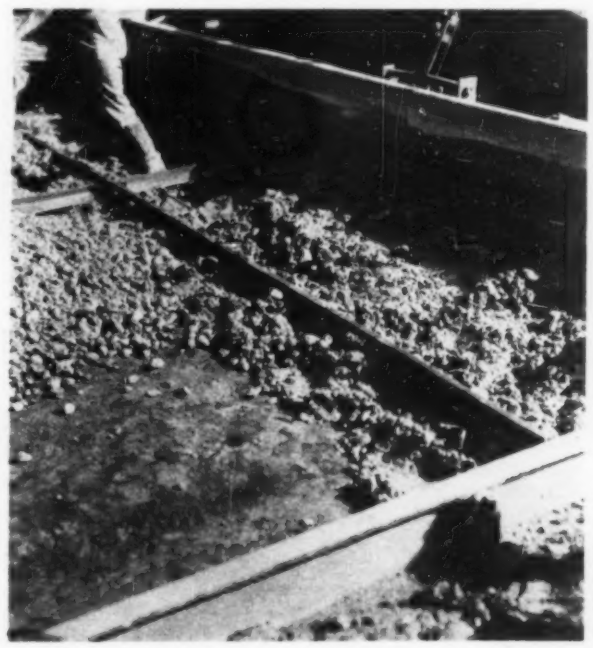
At the start of each half of the project the engineers had the contractor place about 1,000 ft. of pavement without vibration to permit accurate determination of the proportions of a mixture giving standard yield per bag of ce-

**Proposed Concrete Mixtures**

| Ingredients (gravel or stone coarse aggregate) | Standard (not vibrated) | | Vibrated | | | |
|---|---|---|---|---|---|---|
| | | | Yield equal to Standard | | Strength equal to Standard | |
| Cement, lb. | 94 | 94 | 94 | 94 | 94 | 94 |
| Sand, lb. | 220 | 220 | 205 | 205 | 235 | 235 |
| Gravel, lb. | 369 | | 394 | | 462 | |
| Stone, lb. | | 346 | | 371 | | 434 |
| Water, gal. | 5.40 | 5.40 | 4.90 | 4.90 | 5.45 | 5.45 |
| Yield, cu. ft. | 4.77 | 4.63 | 4.77 | 4.63 | 5.44 | 5.27 |
| Cement factor, bbl. per cu. yd. | 1.415 | 1.458 | 1.415 | 1.458 | 1.241 | 1.281 |

IN ADVANCE OF FINISHER *(right)* puddlers pack dry concrete under dowels and flanges of copper-sealed transverse joint, as well as against edge forms and centerline plates.

PRELIMINARY DESIGN *(left)* of concrete mixtures requires only minor adjustments during course of construction. Table gives quantities and yield per bag of cement.



PORTABLE VIBRATORY PLATFORM produces test specimens on job. Electric vibrator is attached to under side of plank suspended from horizontal beam.

ment. This yield amounts to 4.77 cu.ft. for gravel concrete and 4.63 cu.ft. for stone concrete. The short sections of unvibrated pavement also furnished strength comparisons with the vibrated pavement.

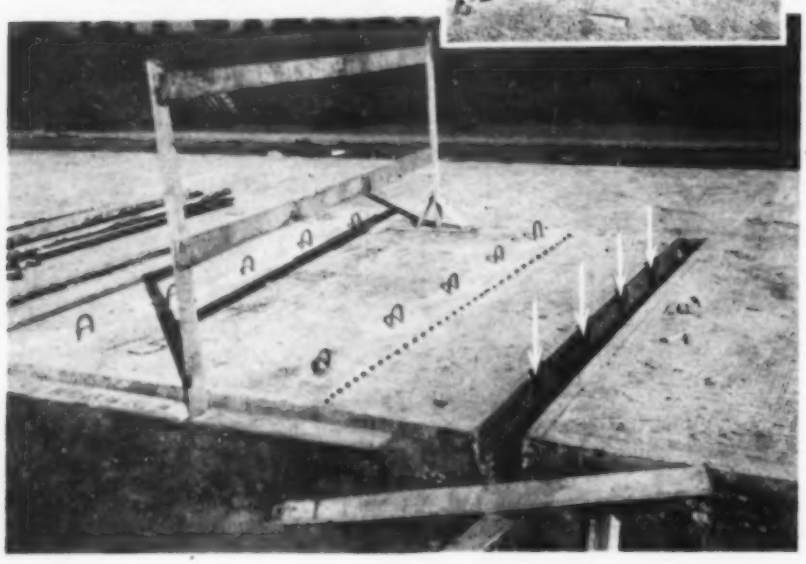
From previous experience with vibration, the Bureau of Materials was able before starting construction to design the tentative mixtures given in an accompanying table. These mixtures proved satisfactory in actual construction and required only slight adjustment after the work had begun.

Coarse aggregate for both gravel and stone sections consisted of a combination of two sizes of gravel or stone, one gradation ranging from 2 in. to 1 in. and the second from 1 in. to ¼ in. To avoid variations in material, the sources of aggregates and cement remained unchanged throughout the job.

*Concrete Pavement* — North of a wye intersection with state route 125 at the south end of the project, the pavement consists of 9-6½-9-in. slab 20 ft. wide (with a 1-in. circular crown) on a 40-ft. graded roadway. The 9-in. thickened edge tapers to 6½ in. in 2 ft. Grading of the roadway section involved 86,000 cu.yd. of earth excavation.



SPECIAL TEST PANELS *(below)* placed, finished and cured with remainder of pavement contain 2x2-in. dividers which produce cracks *(right)* separating slab into beams for testing flexural strength of concrete. Punched holes in concrete permit breaking off ends of beams to desired length. Lifting of each specimen is aided by U-bolts.



Copper-sealed all-metal air-chamber expansion joints are placed 90 ft. apart in the pavement, with copper-sealed all-metal contraction joints at 30-ft. intervals between them. All joints are doweled with J-bars for load transfer. A keyed and doweled longitudinal center-line joint is formed with crimped steel plates.

One purpose of the project was to determine the effectiveness of vibration in consolidating concrete at copper-sealed expansion and contraction joints, as well as alongside the steel edge forms. For this reason, vibrated sections of the concrete pavement were built without spading at the joints or alongside the forms. It was necessary for the concrete puddlers to exercise care in placing concrete under the dowels and under the horizontal flanges of the copper seals. Otherwise the harsh concrete mixtures would not flow satisfactorily under these obstructions and probably would leave some pockets and small voids at these points. Stripping of a vibrated joint at the beginning of the project, where absolutely no effort had been made to pack concrete under the dowels and seal flange, revealed such pockets and voids. Thereafter the puddlers shoveled concrete under the dowels and seal flanges on both sides of each joint before vibration was applied.

Edges of the pavement revealed complete consolidation of the concrete with practically no traces of honeycomb, giving evidence that for this part of the slab vibration did as good a job as could have been done by spading.

*Paving Plant* — Fine grading immediately ahead of the mixer was aided by a tractor-drawn subgrader and a subgrade planer riding on the forms. Illinois specifications do not permit the paving mixer or batch trucks to travel on the subgrade. A 1936 Koehring 27-E paver ran on the earth shoulder outside the forms. Two-batch trucks hauled dry materials to the mixer from a plant set up at a railroad siding about 2 mi. from the south end of the job.

VIBRATED PAVEMENT placed and finished without spading reveals dense, smooth edge after forms are stripped.

VIBRATING REED TACHOMETER held in two hands resting on front screed indicates frequency of pulsations.

To handle with speed the three sizes of aggregate at the batching plant, the contractor operated two clamshell cranes, one using a 1¼-yd. bucket and the other a ¾-yd. bucket. Both cranes unloaded aggregate directly out of gondola cars. The larger unit handled the two sizes of coarse aggregate into a two-compartment overhead bin of 60-ton total capacity equipped with a pair of batchers, one for each size of aggregate. Sand was raised by the smaller crane into a separate 15-ton bin equipped with a single batcher. The two overhead bins were placed close to the track in easy reach of cars and stockpiles, but the arrangement of the bins required that the batch trucks back under each of them.

*Paving Program* — A contract for the work was signed on Aug. 24, 1936. Because of the lateness of the season, the contractor started his grading outfit near the center of the project, where little earth moving was required, and 6 days later began paving on the same part of the job. The first pavement was laid Sept. 24. During the first ten days of paving, fine grading was pushed with minor regard to true subgrade, and average overrun exceeded 3 per cent.

Gravel coarse aggregate was used on the first half of the project. During the first day and part of the second, the paving crew placed 1,026 ft. of unvibrated gravel concrete pavement. After completing 1,650 ft. at the center of the project, the paver moved south and began paving north to a connection with this slab.

Vibrated gravel concrete was placed for 2½ mi. The coarse aggregate then was changed to crushed stone, and the paving crew placed about 1,000 ft. without vibration before returning to the use of vibratory finishing.

*Handling Dry Concrete*—When placing standard mixtures without the use of vibration, the contractor employed a crew of five puddlers. After changing to vibration, the contractor at first eliminated the two spaders and used only three puddlers. To assist the three men in handling harsh concrete, the mixer operator spread the batches as much as possible in dumping. This method of dumping proved unsatisfactory because it threw the large aggregates against the forms and joints. It was found necessary to use five puddlers in spreading and placing the concrete on each side of the transverse joints and against the side forms in advance of the concrete deposited by the bucket. Spreading by hand eliminated the segregation with its resultant stone pockets which filled with water under the vibrator and produced voids.

*Progress* — Illinois specifications require a 60-sec. mixing period with all materials in the drum. On this job, the batch meter was set at 62 sec., allowing 2 sec. for the dry materials to slide into the drum after the skip had reached the top of its rise. Utilizing the 10 per cent allowable overcharging of the 27-E paver, each batch contained 29.7 cu.ft.

TWO CRANES handle three sizes of aggregate from gondola cars to stockpiles or bins at batching plant on railroad siding.

In 49 hr. 20 min. actual operating time during the first 7 paving days, the construction force placed 1,978 batches in 5,036 lin. ft. of pavement, an average of 40 batches and 102 lin. ft. per hour. On the best day in this period, the paving crews placed 515 batches and finished 1,314 lin. ft. of pavement in two 5½-hr. shifts, an average of almost 47 batches or 120 lin. ft. of pavement per hour. After the two crews had been thoroughly broken into their duties, they settled down to a steady pace that slightly exceeded the average of this best day.

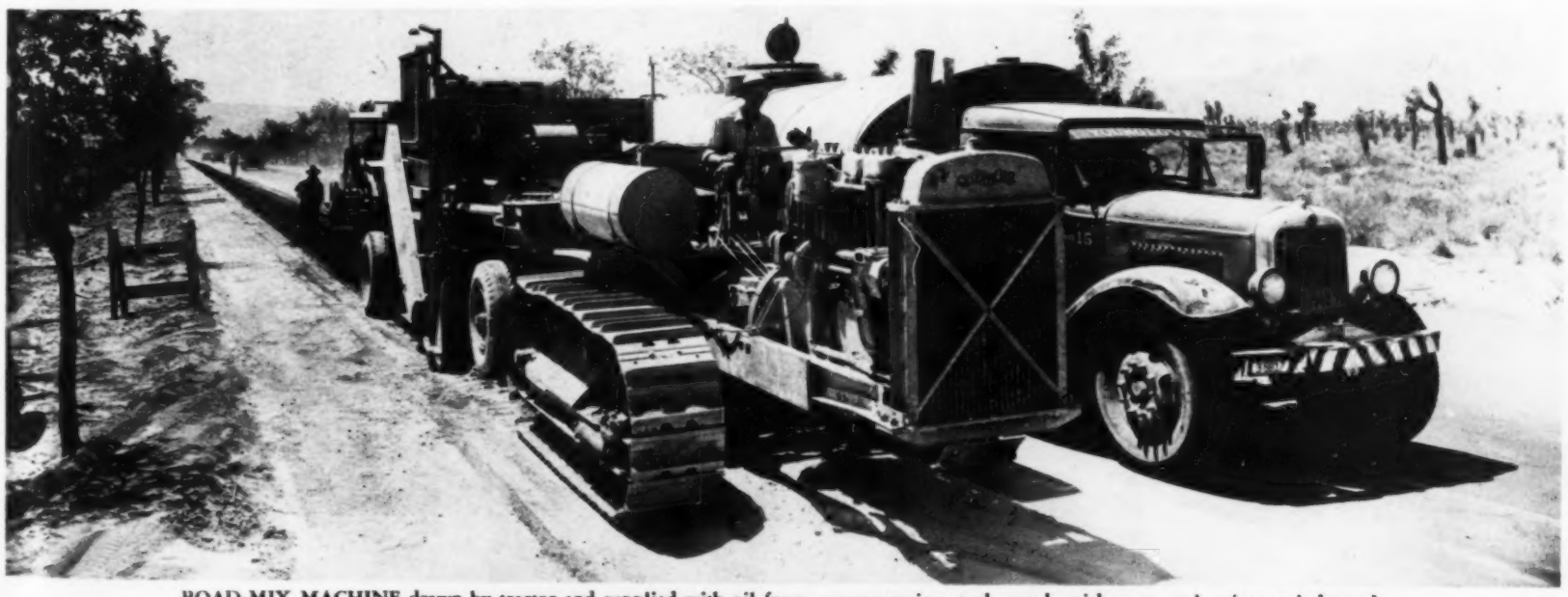
*Special Test Specimens* — To obtain actual flexural strength of the slabs, special test panels were constructed in the pavement and were vibrated in the regular course of operation by the finishing machine. The test panels were separated from the rest of the slabs by wooden bulkheads which were removed the third day following placement of the concrete. The test units were cured in place with the pavement

Vertical holes punched in the concrete while it was soft and longitudinal wooden dividers cast in each test slab form planes of weakness in the panel by which it can be separated into 2x5-ft. by 6½-in. beams for testing. These beam units are lifted from the pavement by means of U-bolts anchored in the concrete. Because of the cool weather prevailing when the pavement was placed, the test units will be taken to the laboratory and cured outside as pavement until tested in the spring.

Beams and cylinders were made during the morning and afternoon shifts of each day's run. To vibrate the specimens the Bureau of Materials' engineers devised a portable vibratory platform suspended in two slings from a timber beam resting on two horses. A Jackson high-frequency vibrator attached to the bottom of the platform was driven by power from the motor-generator set on the finishing machine.

*Administration* — Ernst Lieberman is chief highway engineer of the Illinois Division of Highways, and V. L. Glover is engineer of materials in charge of the Bureau of Materials. Supervision of construction was shared jointly by engineers of the Bureau of Materials and engineers of the Springfield district office of the Division of Highways. C. M. Slaymaker is district engineer. For the contractor Rodney L. Bell was in charge of construction.

# Diesel Engine Powers California Road Oiler



ROAD-MIX MACHINE drawn by tractor and supplied with oil from accompanying tank truck picks up and mixes windrowed material on shoulder of California highway. Diesel engine mounted on road oiler drives two mixing units.

ONE OF THE first diesel-powered road oilers on the Pacific Coast is operated by Cal Cook of Road Mix, Inc., Los Angeles. Power is supplied by a six-cylinder Cummins diesel engine. The road oiler has a four-wheel chassis carrying two mixing units on either end of the frame — cross-wise to the road. It is capable of handling oil or cut-back asphalt for shoulder work. The entire unit is pulled by a Caterpillar tractor.

The engine has a bore of 4⅞ in. and a stroke of 6 in. At 1,800 r.p.m. it develops in excess of 125 hp. Weight of the engine is only 2,120 lb., making it suitable for mobile operations. Starting is with a 24-volt electric system which requires neither glow plugs nor gasoline for instant starting. The engine is mounted over the mixing units, which are chain-driven by the diesel engine at a fuel consumption of 4 gal. of oil per hour for rotating the mixers. The entire unit, consisting of tractor, road oiler and tank truck, lays 2½ mi. of shoulder per 8-hr. day. About 600 bbl. of road oil is put through the mixer in an 8-hr. shift.

Cal Cook, operator of the unit, reports that the diesel engine on the mixer is more flexible than the gasoline engine it replaced and that the upkeep is about one-third that of the former engine. Fuel costs are a fraction of what they formerly were. The gasoline tractor towing the diesel-powered road oiler has been replaced with a diesel tractor because of the satisfaction given by the diesel engine.

TRACTOR *(left)* operating special scraper set on header boards used for grading to true section prior to rolling.

SPECIAL SCRAPER *(below)* prepares subgrade prior to rolling.

TRUCK *(below)* discharging asphaltic concrete paving mixture into 8-ft. spreader box.

# Bay Bridge Approaches Paved With Asphaltic Concrete

ONE OF THE outstanding road construction jobs in the East Bay area under the supervision of the California Division of Highways for directing heavy automobile traffic to and from the recently completed San Francisco-Oakland Bay bridge is the 4½-mi. main approach, known locally as the Mole project. This stretch of multi-lane highway, surfaced with asphaltic concrete, extends from the east end of the bridge structure, running parallel to the Key Route mole at the edge of the northerly shore line, to the distribution structure, and then continues northerly along the waterfront to a point opposite the foot of Folger Ave. in Berkeley, Calif.

*Design* — Between the bridgehead and the toll plaza for a distance of about 2½ mi. highway is divided into six 10-ft. lanes for automobiles and two 22-ft. lanes for trucks, the former being a direct continuation of the upper deck of the bridge, while the latter on either side enter the lower deck of the bridge. The automobile and truck lanes are separated from each other by 5½-ft. parkway strips with concrete curbs, and the truck lanes are flanked by 10-ft. shoulders. Light standards are installed in the parkways.

The section between the toll plaza and the distribution structure differs from that above described in that a 5½-ft. parkway strip, curbed and containing the light standards, is in the center, thus dividing the road into two 32-ft. lanes on either side, flanked by 10-ft. shoulders. The remaining portion of the highway project north of the distribution structure, which deflects considerable traffic, consists of a four-lane road with a 10-ft. parkway strip between the two 20-ft. roadways, also flanked by 10-ft. shoulders. Highway authorities selected the divided highway design to prevent collisions.

As the roadbed proper consists of hydraulic sand fill subject to periodic subsidence, several factors had to be investigated before final adoption of the asphaltic concrete paving now used. The fill was placed by a hydraulic dredge about two years ago, the material being taken from the floor of San Francisco Bay. During this work, subsidence studies were conducted and rates of settlement determined over every portion of the work, under each successive stage of embankment. Final grade was established between El. 15 and 19, depending on the depth of the underlying material and based on estimates as to future settlement over a period of years. When the fill finally reaches equilibrium it is estimated that the grade over the entire section will be near El. 14. The sand-fill and the riprap on the seaward side for protection of the roadbed from wave action were placed under separate contracts.

In view of the close proximity of the bay, reducing temperature fluctuations to a minimum and providing a moderate year round temperature, it was found possible to use a paving mix with a higher asphalt content than under ordinary conditions. The greater flexibility provided thereby materially reduces the possibility of cracks and breaks while subsidence continues. Proportions of aggregate for the asphaltic concrete mix used on the project are as follows: Base course: size, 2 to ¾ in., 30 per cent; ¾ to No. 3 mesh, 31 per cent; No. 3 to 10 mesh, 10 per cent; 10 mesh to dust, 29 per cent, and asphalt, 5.1 per cent. Surfacing contains 40 per cent of material ranging from ¾ in. to No. 3 mesh; 20 per cent No. 3 to No. 10 mesh; 34 per cent No. 10 to dust; 6 per cent dust (ground pumice); and 6 per cent asphalt. All paving materials are pre-

FINISHING MACHINE smoothes surface of asphaltic mix.

SPREADER BOX attached to truck chassis by chain is towed in front of finishing machine.

COMPLETED ROAD section from bridgehead to toll plaza contains six 10-ft. lanes for automobiles and two 22-ft. lanes on outside for trucks.

INSPECTOR with 6-ft. straight edge indicating surface irregularities for correction by transverse rolling.

pared in a mixing plant erected by the contractor in a highly industrialized area about 1 mi. from the project. Because a large food packing plant is situated near by, and the fine material in the aggregate was deficient, the plant was provided with effective dust control and conservation equipment. Capacity of the mixing plant is 125 tons per hour.

The different grades of aggregate are delivered by railroad and stacked in piles by a belt conveyor equipped with an airplane tripper. A second conveyor, operating in a tunnel under the piles, removes the type and quantity of aggregate determined by the superintendent and delivers it to the revolving dryer, which is housed in a corrugated metal shed with a dustproof roof. The exhaust from the dryer and the dusty air from the aggregate bunkers over the mixer and from the mixing floor are treated in cyclone-type dust collectors installed at convenient points. Collected dust goes to a special room where it is precipitated by a jet of live steam and returned to the bin of fines. Asphalt is delivered in tank cars and stored in steel tanks adjacent to the mixing plant.

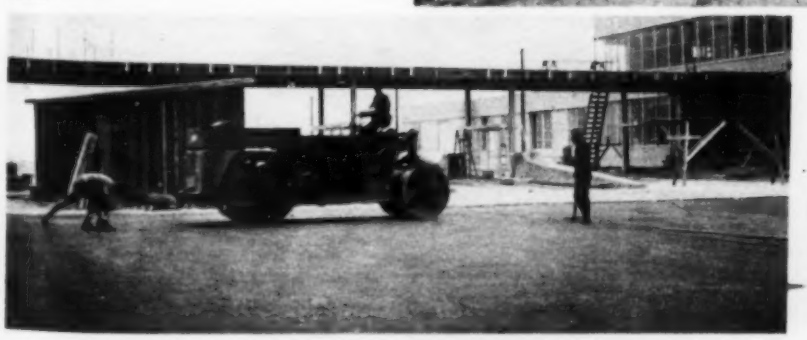
All material is prepared in a 30-cu. ft. mixer, and the conventional truckload consists of 5 mixer batches. The finely ground pumice mentioned previously is delivered in sacks and elevated to the bins by a bucket elevator. The 60-in. by 24-ft. dryer is fired by natural gas, which is another departure from standard practice. Apart from eliminating the dust nuisance, the design of the plant has reduced the loss of fines commonly estimated at from 5 to 8 per cent in the ordinary plant setup on highway work to about 1 per cent.

ROLL-A-PLANE ROLLER doing longitudinal work.

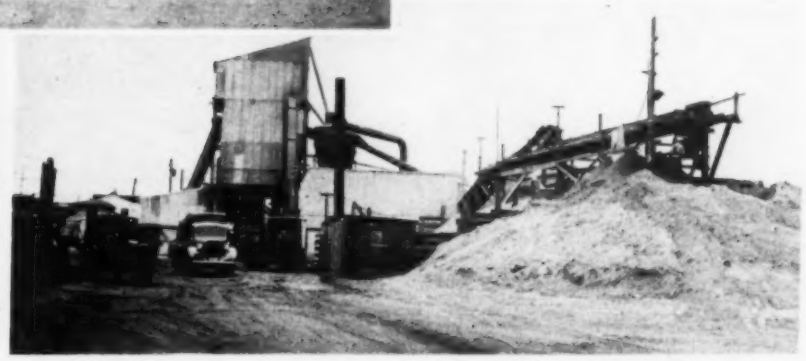
*Paving Operations* — Paving of the 4½-mi. section of bridge approach was done under a contract awarded to Hanrahan-Wilcox Corporation, San Francisco, for the amount of $247,253. It calls for placing 41,500 tons of crusher run base, 45,500 tons of imported material, and 31,515 tons of asphaltic concrete. Material contained in the filled-in roadbed amounts to more than 4,000,000 cu.yd. Preliminary work carried out consisted of laying over the sand fill a 4-in. course of imported material, an altered Leona rhyolite quarried in the hills near Oakland, Calif., and delivered to the project by trucks. When excavated this material breaks up into small lumps and cements into a very tight base under hauling and rolling. The primary reason for laying this course was to prevent the crusher run base from entering the sand fill, thereby causing dispersion and loss of bearing value.

Upon completion of this work, a course of crusher run base, varying in thickness from 4 to 6 in. according to the type of traffic to be carried, was laid. Standard scrapers were used for preliminary grading, while grading to true section prior to rolling was done by a special scraper towed by a small tractor operating on stationary side forms commonly called header boards. After the crusher run base had been thoroughly compacted by rolling, placing of the two layers of asphaltic concrete paving was started. The base course was placed to a compacted thickness of about 2½ in., followed by a surface course 1½ in. thick. The paving proper was placed by conventional methods. Usually base course was laid one day, followed the next day by top surfacing. Material was brought from the mixing plant to the project by trucks, which discharged into 8-ft. spreader boxes. These were attached to the truck chassis by chains and towed in front of an Ord finishing machine, resting on removable steel bands set on the wooden header boards. The finishing machines used on the job were adjusted to facilitate paving of the 20-, 22-, 30-, and 32-ft. strips. Longitudinal rolling was started immediately after passage of the finishing machine. Scattering of asphalt-coated stone chips to provide the necessary non-skid surface was done by hand from a wooden sled shod with steel runners towed by a truck. About 7 lb. of this material was used per square yard. Following an Austin-Western Roll-A-Plane roller inspectors applied portable 6-ft. straight edges to indicate surface irregularities to be ironed out by three rollers working in the transverse direction behind. All work on the project was done on a two 6-hr. shift-per-day schedule.

*Personnel*—For the California Division of Highways, of which C. H. Purcell is state highway engineer, the construction of the project was under the supervision of John H. Skeggs, division engineer, with Lloyd Marshall in immediate charge as resident engineer. Marshall Hanrahan and J. P. Guerin, general superintendent, direct operations for Hanrahan-Wilson Corp., contractors, San Francisco, Calif.



ROLLER doing transverse work in the vicinity of the toll plaza.



SCATTERING *(top photo)* asphalt-coated stone chips from wooden sled towed by truck.

MIXING PLANT which supplies asphaltic concrete to job.

# Getting Down to DETAILS

***Close-Up Shots of Road-Building Methods and Equipment***

**SPRING-TOOTHED HARROW**
drawn by pneumatic-tired Allis-Chalmers farm tractor *(left)* is used by Summit Construction Co., to prepare 22 mi. of bituminous road mix surface in Cottonwood, S. D.

**MECHANICAL SPREADER**
distributes truck-mixed concrete on four-lane superhighway, 42 ft. in width, on U.S. Route 19, 8 mi. north of Pittsburgh, Pa. Slab is concreted in 21-ft. widths by McCrady Construction Co., of Pittsburgh, employing Jaeger transverse belt conveyor machine to receive 3-yd. batches of concrete from Transit mixers and spread it across 21-ft. width between forms. Following spreader, Lakewood finishing machine completes slab.

"With this outfit," reports W. F. McCrady, "we were able to average 100 lin.ft. of 21-ft. slab, 9 in. thick, per hour."

**SPECIAL DIPPER**
of 3-cu.yd. capacity, rigged on Koehring shovel of ¾-yd. normal size, speeds up removal of snow from highways in Milwaukee County, Wis.

**FIRM ROAD SHOULDERS**
in Rhode Island are obtained by laying strips of cotton fabric *(above)* on sandy base and applying cut-back asphalt. After applying ½ gal. of asphalt *(left)* per square yard to sand, cloth in 4½-ft. wide strips, is unrolled from spool on truck and sprayed with ¼ gal. per sq.yd. and covered with sand followed by a second ¼-gal. treatment and a sand blotter course to finish the surface.

## DOUBLE-HEADER COMBINATION

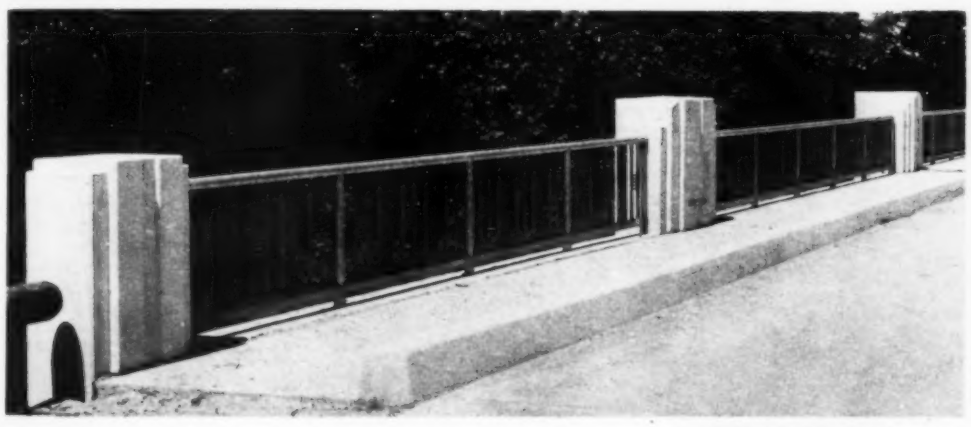
of elevating graders is employed in Nebraska for side-casting from wide, shallow borrow pits. Material from belt carrier of first unit discharges into hopper above moving belt on second unit, thus doubling lateral reach of single machine. — *Photo from* A. T. LOBDELL, *State Highway Engineer of Nebraska.*

## OVER THE TOP

Batch trucks of Booth & Olson, Inc., of Sioux City, Ia., use independently supported bridge to cross over power subgrading machine on paving contract near Alta, Ia. — *Photo from* E. W. BLOM, *Assistant Engineer, Iowa Highway Commission.*

## FOR CLEANING EXPANSION JOINTS

when filler material has been squeezed up above concrete slab during hot weather, Wayne County, Mich., uses tractor-hauled hook with sharp cutting edge made from 6-in. piece of grader blade to shave off surplus material forming ridges.



## BRICK PARKING STRIPS

to catch oil drippings from motor vehicles standing along curb and to prevent ruts from big trucks, are installed along bituminous paved street in Minneapolis. Strips are 6 to 8 ft. wide, using vertical fiber, lug-type brick, 2½ in. deep, with asphaltic filler.

## ORNAMENTAL HAND RAIL

on bridge in Cook Co., Ill., presents pleasing appearance and permits view of stream often hidden by rails of more massive type. Made of copper-bearing steel installed at contract price of $4.50 per linear foot.—*Photo from* E. L. GLOVER, *Illinois Division of Highways.*

## DITCH CLEANING

along Washington state highways, is handled by this rig *(above and at right)* consisting of bucket elevator on truck delivering to belt conveyor discharging into second truck. This outfit removes excess material first dug from ditch by blade grader and windrowed on road shoulder. — *Photo from* L. V. MURROW, *director of highways, State of Washington.*

# Construction Equipment News

(All rights reserved)

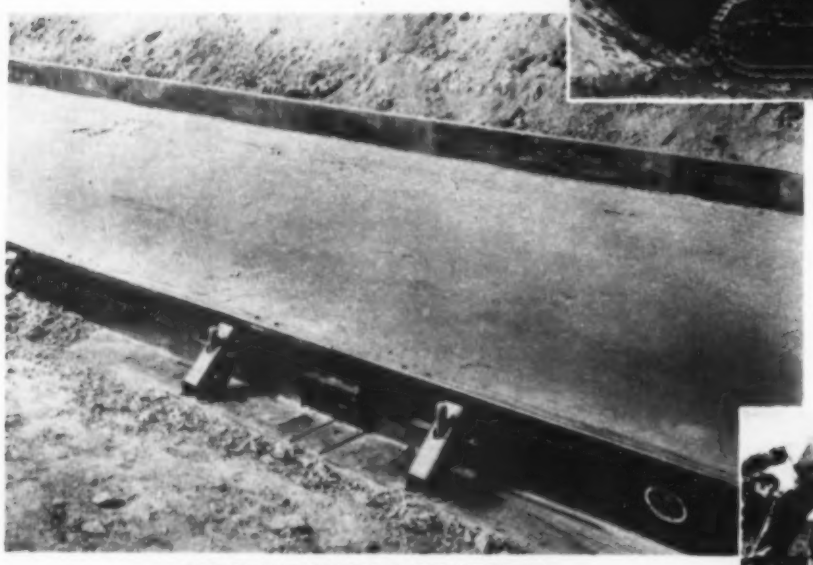
Review of Construction Machinery and Materials for January, 1937

## MESH STRIKE-OFF MACHINE

for striking off concrete below forms to whatever depth specifications call for to allow for placing of reinforcing mesh and steel. Equipped with 2-cylinder, 8-hp. engine, with transmission unit for speeds forward and backward, and arranged and underslung to permit paver bucket to swing over center section. Reciprocating strike-off blade can be set to various crowns of pavement. Sizes from 10 to 20 ft. Weight, 10-ft. unit, 2,900 lb.; 20-ft. unit, 4,100 lb. — Flexible Road Joint Machine Co., Warren, Ohio.

## HIGH-SPEED 1-YD. EXCAVATOR

*(below)* with tractor crawlers is latest addition to P&H line of material-handling equipment. Designed as an all-purpose machine, weight has been reduced by use of new high-tensile steels and electric welding. Reinforced cylindrical carbody welded integrally with crawler frames assures proper speed and weight conditioning. Two-speed transmission makes possible accurate inch-spotting in crane work without necessity of re-reeving hoist cable. Two hook rollers on front edge of live roller circle and four swivel hook rollers on tipping edge counteract strains and eliminate pull on center pin to permit fast easy swing with heaviest dipper loads. Other features: automotive-type foot pedals; full-vision cab, ample space for operator. — Harnischfeger Corp., Milwaukee, Wis.

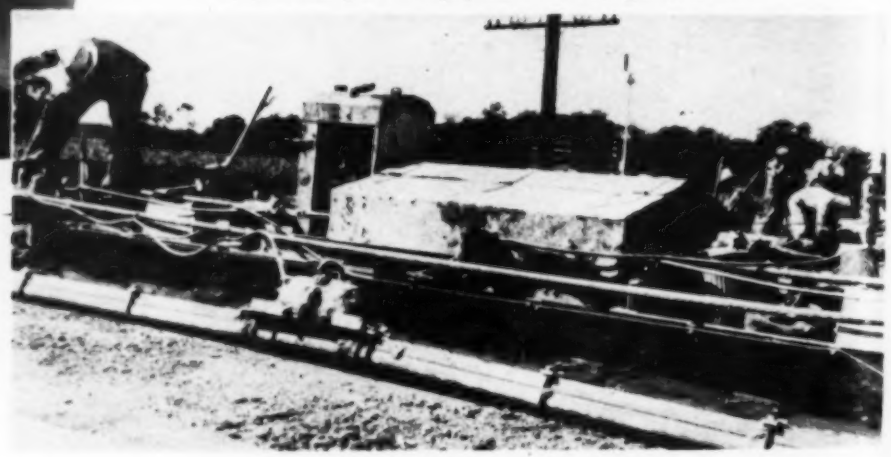


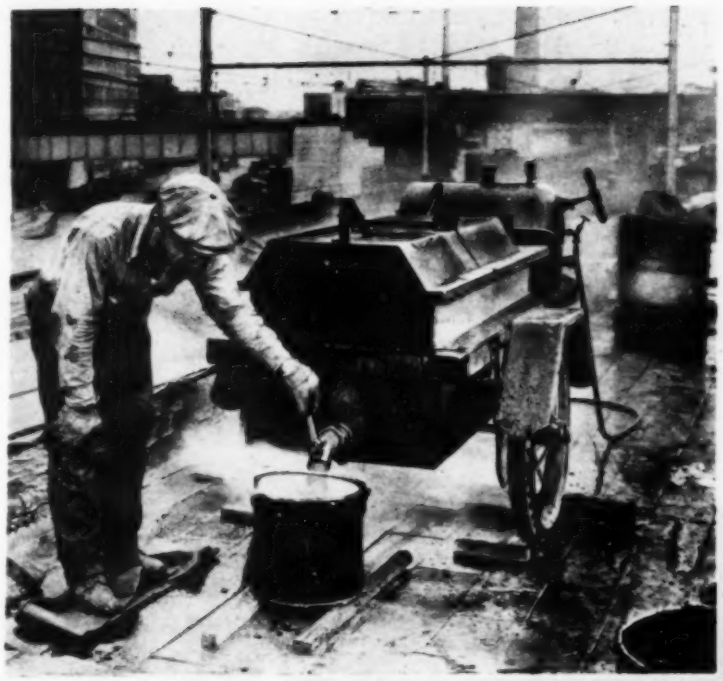
## SELF-ALIGNING FEATURE

of new road form is accomplished with two wedges on each stake pocket. Upper wedge is operated by hand until it contacts stakes, taking up usual clearance between wedge and stake and eliminating movement of form when final locking is done. Lower wedge then is driven up with hammer for final locking, preventing movement of form from line or grade and permitting quick and accurate form setting even though stakes be bent or driven crooked. — Blaw-Knox Co., Pittsburgh, Pa.

## VIBRATORY TUBE

*(below)* attached to any type finishing machine makes possible internal vibration of concrete paving slabs. Unit consists of 4-in. steel pipe which spans width of pavement to within 3 in. of side forms. Upon pipe at center is mounted powerful electric vibratory motor powered by portable gas-electric generating unit on finishing machine. Tube, raised or lowered by conveniently located lever, is effectual means of completely puddling and compacting concrete in advance of reciprocating screed and works within roll of concrete carried by that member. Handles 1-in. slump concrete and leaves plastic material for finishing and subsequent operations. Also puddles concrete adjacent to transverse joints and side forms, saving additional machinery and labor. — Electric Tamper and Equipment Co., Ludington, Mich.



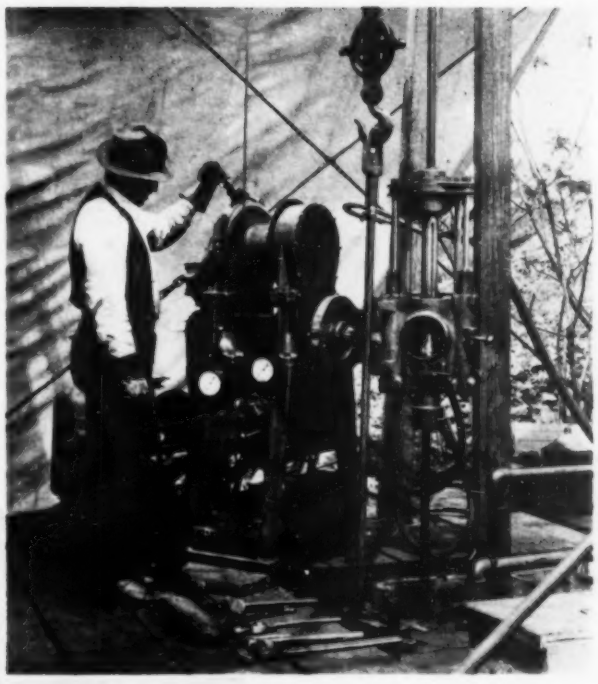


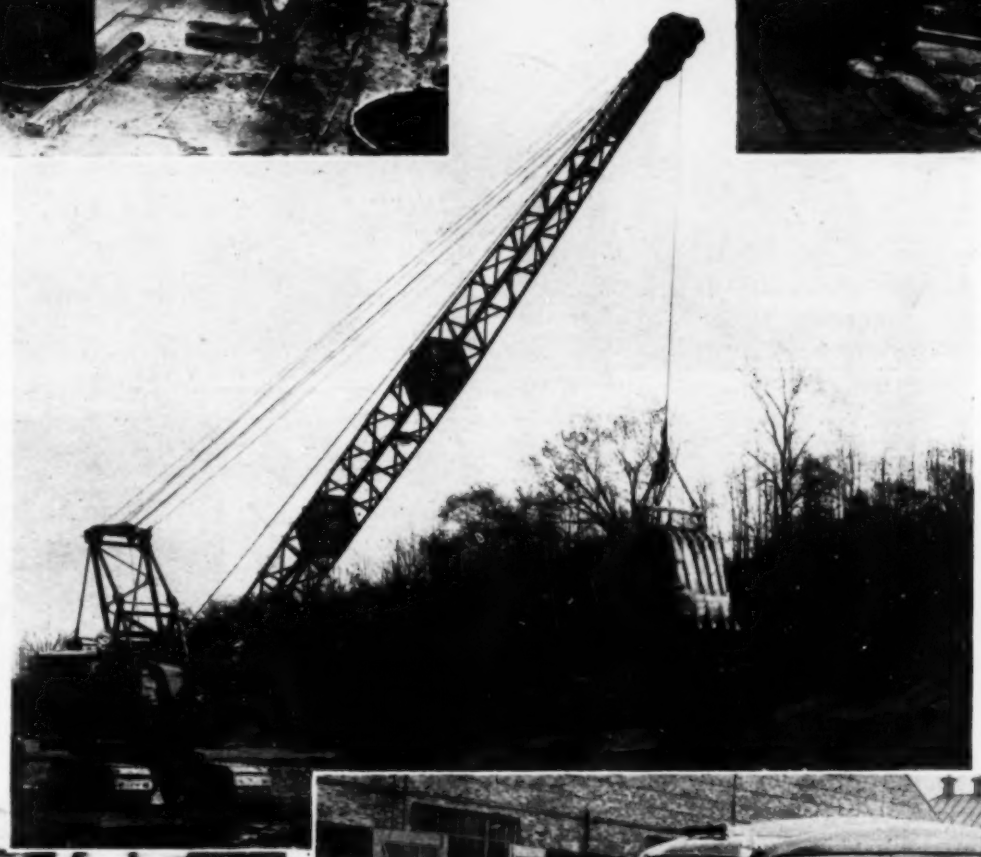
## TAR AND ASPHALT MELTING KETTLE

known as "Speed-Master", for use of roofers, waterproofers, bituminous paving contractors and highway departments. Unique design of unit employs new heating principle, eliminating heat losses and kettle bottom burnouts. In "Speed-Master" heat from burner is distributed by double return tube heating system inside kettle completely surrounded by asphalt or pitch, causing rapid melting of kettle contents and cutting fuel consumption from 50 to 60 per cent. Another feature, "No-Freeze" drawoff cock, prevents cold material from freezing in cock. Use of kettle doubles melted material production, melting 14 drums of asphalt or 25 bbl. of pitch in 75-gal. kettle per 10-hr. day, whereas two conventional-type kettles would be required to do same work. Built in 25-, 50-, 75- and 100-gal. capacities. —Hauck Mfg. Co., 126-134 Tenth St., Brooklyn, N. Y.

## DIAMOND DRILL

*(right)* equipped with master gage that registers directly in pounds pressure of diamond bit against rock. When soft formation or seam is encountered during drilling, reaction is indicated on gage. Hydraulic control mechanism permits drill to accelerate feed but does not allow string of tools to drop. May be operated by gasoline, kerosene or electric drive. Hoisting of tools facilitated by integral hoist particularly suited to this type of work. Holes to 1,150 ft. producing cores ⅞ in. in diameter, or shorter holes with larger cores up to 3-in. diameter are possible. — Ingersoll-Rand Co., Phillipsburg, N.J.



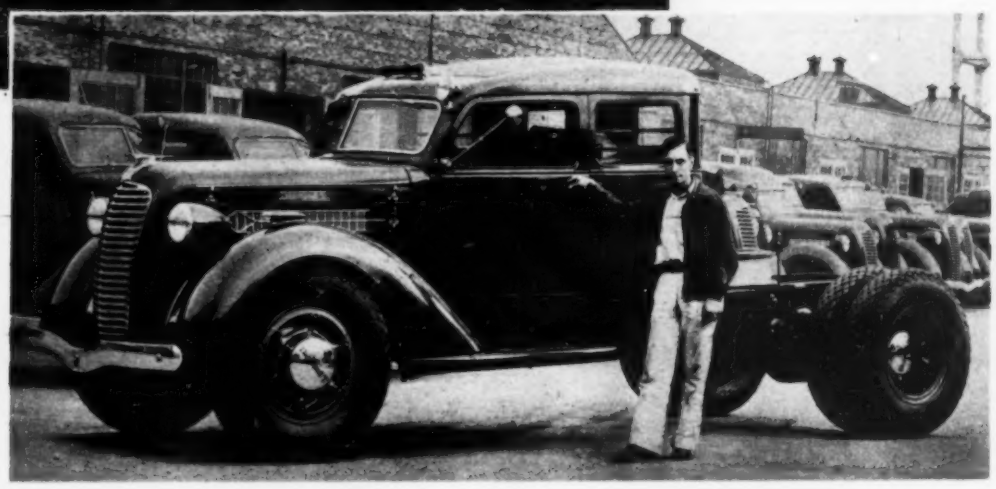


## LONG-RANGE DRAGLINES

*(left)* for heavy-duty performance on drainage projects, extensive stripping areas in mines and quarries and canal excavation, has following features: (1) Substantial, extra high A-frame for boom rigidity and balance; (2) long and extra wide crawlers for stability and low-ground pressure; (3) powerful motor for power in tough digging; (4) swiveling boom point fair lead with large sheaves and drum barrels for increased cable life; (5) full vision for operator. Built in two sizes, with booms from 50 to 70 ft. long, handling buckets up to 3-cu. yd. capacity. — Koehring Co., 3026 W. Concordia Ave., Milwaukee, Wis.

## ADJUSTABLE WRENCH

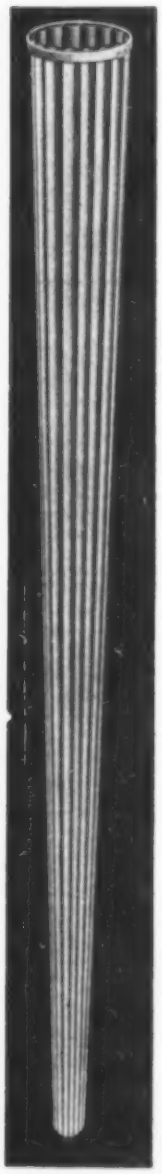
*(left)* has square shoulders on movable jaw shank which overcome wedging and spreading action common to conventional cylindrical bearing and provide positive bearing against working stress. Permits thicker and stronger "web" without increasing total head thickness of wrench. Drop-forged from special carbon steel. "Superadjustable" wrench forged from chrome-alloy steel with "satin" finish handle. Both styles in sizes 4, 6, 8, 10 and 12 in. — J. H. Williams & Co., 75 Spring St., New York City.



## DIESEL TRUCK

light-weight, high-speed, in 1½-3-ton and 2½-4-ton models, built to save operators two-thirds to three-fourths of gasoline costs and to reduce fire hazard. Smaller truck is powered by Hercules 77-hp. engine at 2,600 r.p.m. with 3½-in. bore, 4½-in. stroke, piston, displacement, 260 cu.in., and maximum torque, 178 lb. ft.; larger model by 86-hp. engine at 2,600 r.p.m., with 3¾-in. bore, 4½-in. stroke, piston displacement, 298 cu.in., and maximum torque, 208 lb. ft. Bosch injection system is employed with plunger-type fuel pump, pintle-type nozzles and vacuum governor. Trucks have two-speed rear axles, 30-gal. fuel tank, metal spoke wheels, cam-and-lever steering with ball bearings in steering head and roller bearing cam follower, flat tube and fin core radiator and standard or de luxe cabs. Weights, 13,000 and 17,000 lb. Diamond T Motor Car Co., West 26th St., Chicago, Ill.

**Highway Engineers**
**AND**
**Road Contractors**
**PROFIT** *by Using*



**UNION METAL**
*fluted steel*
**PILE SHELLS**

BOTH engineer and contractor profit from the use of Union Metal Fluted Steel Pile Shells. Here, at last, is a practical method for constructing perfect cast-in-place concrete piles of varying lengths and sizes.

These tapered shells are cold rolled and fluted for greater strength and rigidity. They will withstand hard driving and sustain the load value with a high factor of safety.

Their light weight makes for easy handling and fast driving without aid of special equipment. No cores or mandrels are required. Shells are easily inspected after driving.

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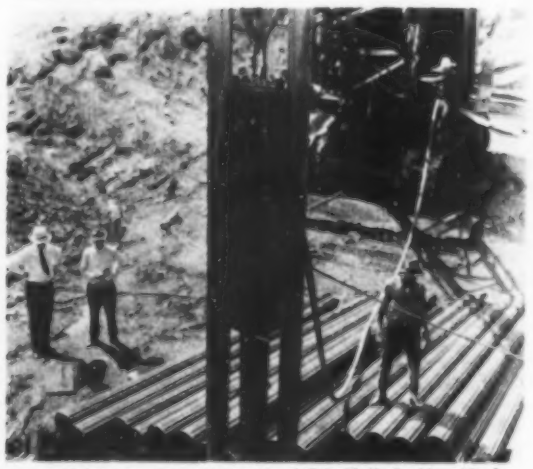
**THE UNION METAL MANUFACTURING CO.**
**CANTON, OHIO**



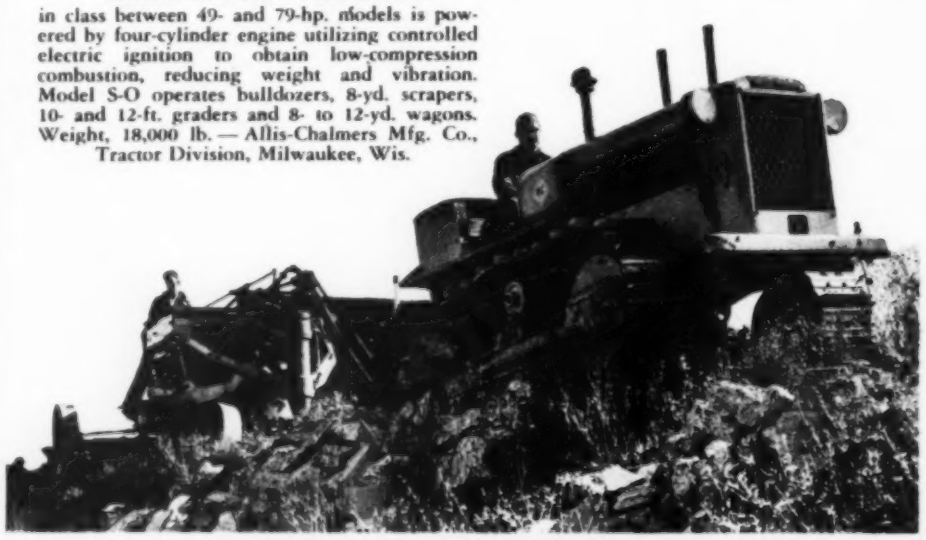
*Driving 11-guage Union Metal Pile Shells for New York Central grade elimination project near Utica, New York.*

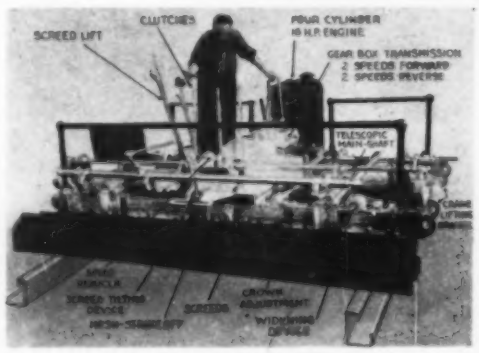

# Construction Equipment News

*(Continued)*

### DIESEL-FUEL TRACTOR

in class between 49- and 79-hp. models is powered by four-cylinder engine utilizing controlled electric ignition to obtain low-compression combustion, reducing weight and vibration. Model S-O operates bulldozers, 8-yd. scrapers, 10- and 12-ft. graders and 8- to 12-yd. wagons. Weight, 18,000 lb. — Allis-Chalmers Mfg. Co., Tractor Division, Milwaukee, Wis.



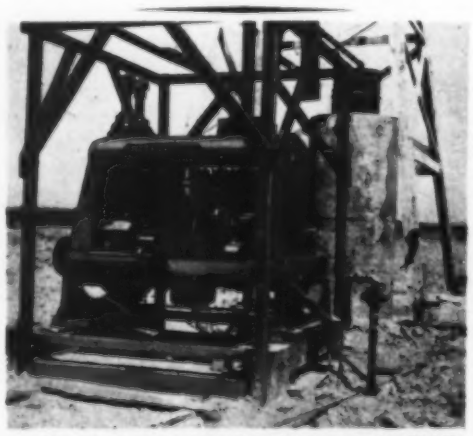



### VERSATILE FINISHING MACHINE

Screeds backward as well as forward. Has built-in gear box transmission, belting attachment, reinforcing mesh strike-off attachment, and quick adjusting crown attachment on screed. Two standard models: (1) for full width construction, adjustable from 18 to 30 ft.; (2) for half width construction, adjustable from 9 to 16 ft. — Flexible Road Joint Machine Co., Warren, Ohio.

### 18-YD. PNEUMATIC-TIRED WAGON

Bottom-dump type. Hydraulic door-winding mechanism and hydraulic brakes operated from tractor seat. Dual rear wheels; single front wheels. Designed for use with 95-hp. tractor. Straight sides drop sticky loads. Big body makes easy spotting under excavator. Low tractive resistance in any kind of soil. — La Plant-Choate Mfg. Co., Inc., Cedar Rapids, Iowa.

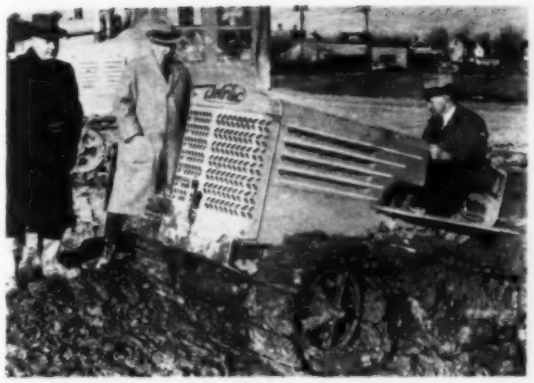


### SIX-CYLINDER DIESEL ENGINE

develops 100 hp. maximum and 80 hp. under continuous load. Special starting method converts engine into conventional gasoline engine for hand cranking, eliminating auxiliary motor or electric starter. Weight, including welded steel base, 3,750 lb. — International Harvester Co., 606 Michigan Ave., Chicago, Ill.

### CAB-OVER-ENGINE STREAMLINED TRUCK

designed to promote safety on highways, to permit ease of handling in traffic and shortest possible overall length. Despite cab-over-engine design, cabs have overall height only few inches greater than conventional trucks. This fact, combined with wide-tread axles, makes center of gravity extremely low and contributes toward exceptional stability on road. Photo shows truck equipped with regulation dump body. — White Co., Cleveland, Ohio.



### TRACTOR STREAMLINED

Sharp angles and projections eliminated in new Cletrac streamlined model. Exhaust carried down and under tractor, instead of coming back in operator's face, improving both comfort and visibility. Positive control, especially operating down hill under load. — Cleveland Tractor Co., Cleveland, Ohio.

### REAR DUMP TRUCK

Designed for faster hauling speed under full load, for quicker dumping action, and for moving material at lower unit cost. Body 10-cu.yd. water level capacity; dual 13.50x24-in. balloon tires on drive wheels. Maximum load capacity, 15 tons. Five speeds forward and two reverse. Service and emergency brakes, four wheels. Cab completely inclosed with full front and side view for operator (window in rear). Euclid three-stage double acting telescopic hoist, 8-in. diameter 37-in. stroke. Powered by Cummins diesel 6-cylinder 125-hp. motor or by gasoline unit, as desired.—Euclid Road Machinery Co., Cleveland.

## *News from Manufacturers*
## ABOUT THEIR PRODUCTS

*The publications reviewed below will keep you posted on latest developments in construction equipment and materials available for your use. If you want copies, ask for them.*

PAVING EQUIPMENT — **Jaeger Manufacturing Co.,** Columbus Ohio. (58 pp., illustrated). Pictorial review of extensive line of road-building machinery including concrete finishers, combined finisher and spreader, bituminous pavers, triple pug-mill bituminous traveling road-builder, adjustable spreader box, concrete spreaders, steel road forms for concrete and asphalt, sub-graders, rooters, float bridges, straight-edges, pumps and concrete mixers. Contains more than 100 action pictures of equipment in actual service, in addition to descriptive data. For quick and clear understanding of machines, design details are pictorialized with explanatory labels, on large scale. Covers gas-electric and vibratory finishing machines and curve-widening attachment. Detailed specifications given for all machines.

• • •

EARTH YARDAGE CALCULATOR — **R. G. Le Tourneau, Inc.,** Peoria, Ill. Slide rule device, conveniently fitting vest pocket, offers quick method of determining time cycles, hourly yardage and cost of earth movement with tractor-hauled carryall scrapers operating over hauls of varying grades and distance. Gives grade limitations with each tractor gear; develops total hauling periods and yardage expectancy under normal working conditions.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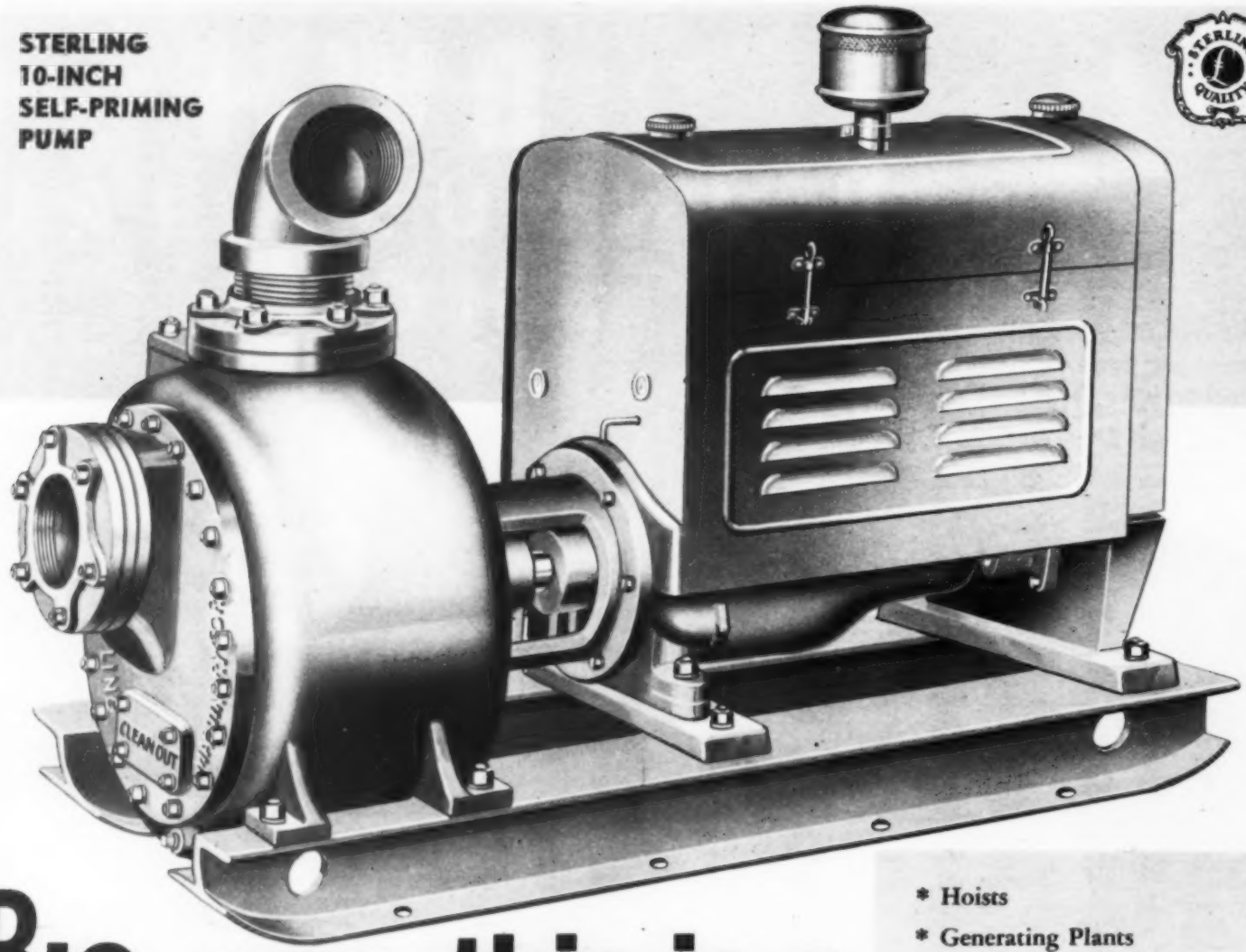



# BIG—yes, this is a BIG PUMP, But . . .

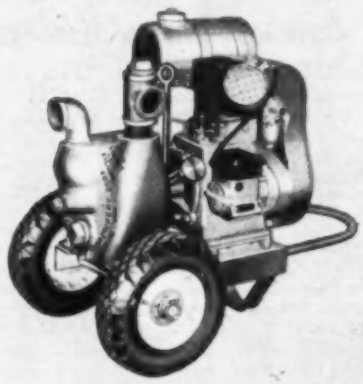
you don't have to have a big job to take advantage of Sterling's Improved Self-Priming Pumps. Sterling Pumps are made in all sizes and meet every requirement. The large 10″ 200,000 gallon pump and the small 2″ 7,000 gallon pump are illustrated.

Insist on Sterling! Rely upon the pump that has the recommendation and carries the good will of all the leading contractors.

Write for complete literature and prices on Sterling equipment.

VISIT OUR EXHIBIT AT THE ROAD SHOW BOOTH C-40

* Hoists
* Generating Plants
* Saw Rigs
* Diaphragm Pumps
* Well Point Pumps
* Self-Priming Jetting Pumps
* Dredge Hoists



**Sterling**
**MACHINERY CORPORATION**
411-13 Southwest Blvd. Kansas City, Mo.

BUILT IN SIZES 3/8 to 15 CUBIC YARDS

# 50% MORE DIRT *Moved with a* PAGE AUTOMATIC



## Users Report On Yardage Increases— Read What They Say:

***A Contractor writes:***

* "It comes nearest to doing the work of a shovel bucket in rock, with all the advantages of the dragline that I believe possible."

***From a gravel plant owner:***

* "Has increased our production at least 75%. To us the Page AUTOMATIC is the *only* bucket for dragline work."

***A strip mine operator says:***

* "Can truthfully say that since putting on your AUTOMATIC we are stripping at least 50% more material."

**From letters in our files.*

You also can increase your yardage and dragline profits! For information on a size and weight AUTOMATIC bucket for your machine and job—see your equipment dealer or write us direct. Free bulletin "The AUTOMATIC" gladly sent on request.

**"DIG WITH A PAGE AUTOMATIC"**

# Page Engineering Co.

*Clearing Post Office • • Chicago, Ill.*

**PAGE AUTOMATIC DRAGLINE BUCKETS**
**PAGE WALKING DRAGLINE MACHINES**
**PAGE DIESEL ENGINES**

PAGE ENGINEERING COMPANY
CLEARING POST OFFICE CHICAGO, ILLINOIS

Please send bulletin on the Automatic Dragline Bucket in the_____cu. yd. size

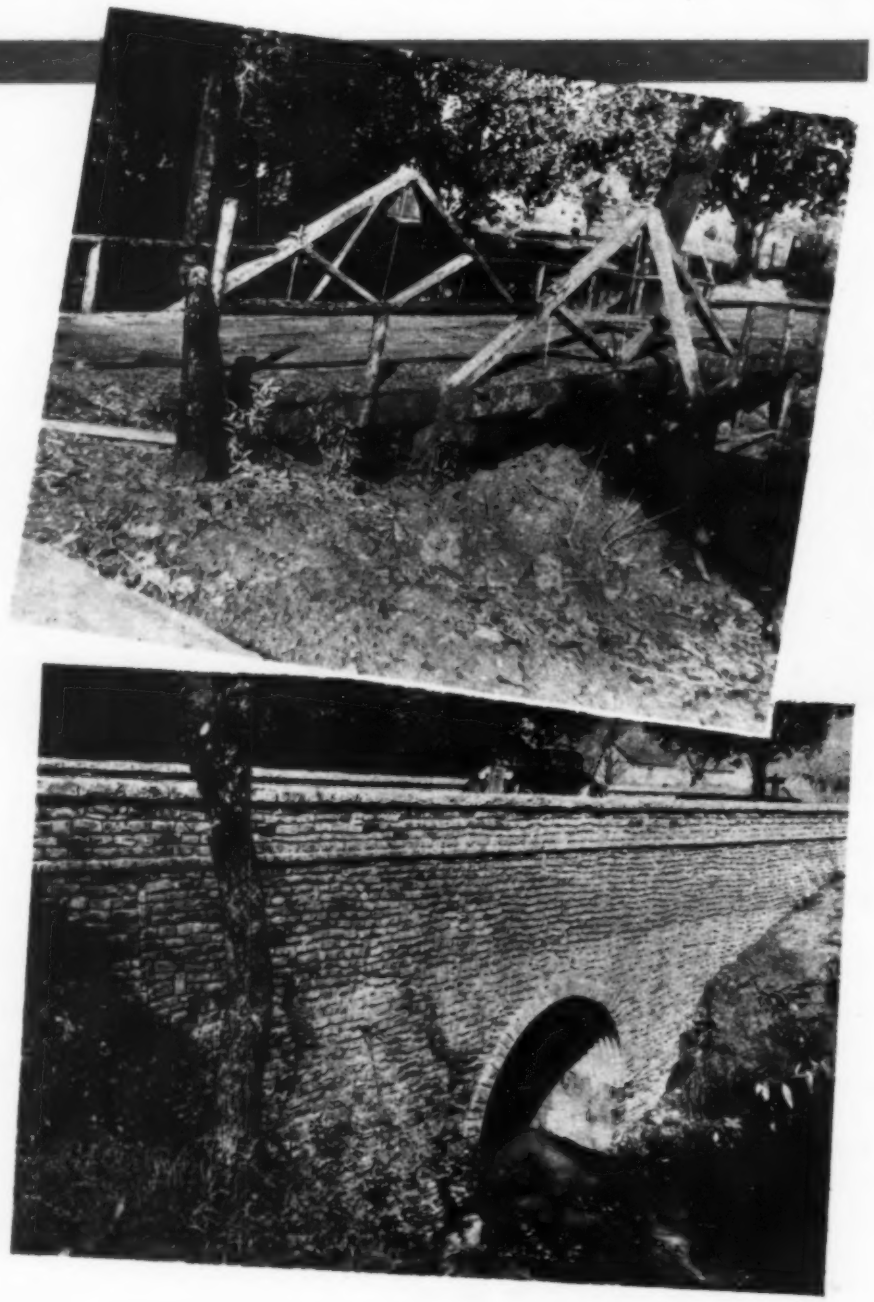
*Name*_____

*Address*_____

*City*_____ *State*_____ "S

# TO MAINTENANCE COSTS

**HERE'S A SURE WAY TO ELIMINATE PAINTING, RE-FLOORING, FIRE DAMAGE AND OTHER COSTLY BRIDGE REPAIRS**



● These pictures tell the story. Instead of spending money for further repairs on this wooden bridge, the officials wisely replaced it with a sturdy Armco Multi Plate arch. The arch itself consists of heavy-gage corrugated iron plates bolted together and securely anchored in the concrete footings.

This metal arch has ample strength to support the heaviest loads. Being made of durable Armco Ingot Iron, it should last a lifetime—without upkeep or repairs. If conditions change, it can easily be widened or relocated without any loss of material.

Let an experienced Armco man help you obtain these advantages on your next small bridge replacement. And remember, unskilled labor can put up a Multi Plate structure almost as quickly and economically in winter as in spring. To get complete information just fill in the coupon and address it to:

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MIDDLETOWN, OHIO

# ARMCO MULTI PLATE

☐ Send Me your latest free catalog describing Armco Multi Plate construction.

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(CM-1-37)

# NOVO FULL STREAM LINE SELF PRIMER

## *Going to the Show*

### *Look it over—Think it over*

**This little package of dynamic energy can throw more water than you would expect from two pumps its size.**

**This Novo 2-inch Self-Priming Centrifugal Pump has the remarkable capacity of 6500 GPH A.G.C. Rating.**

**Smooth to handle—well balanced, and light in weight—150 lbs. You can have it with or without the double protection handles and air wheel. It's the neatest little job you ever saw.**

**Drop in at Booth A-69 at the New Orleans Road Show, or mail the coupon and we will tell you about the constant duty seal, the roller bearing stream line power unit, the remarkable price, and you can see for yourself the compact, symmetric design.**

**There is a full line of self-priming centrifugal pumps up to 90,000 GPH with every type of mounting available.**

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2-inch Full Stream Line Pump_____
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## for Engineers and Contractors

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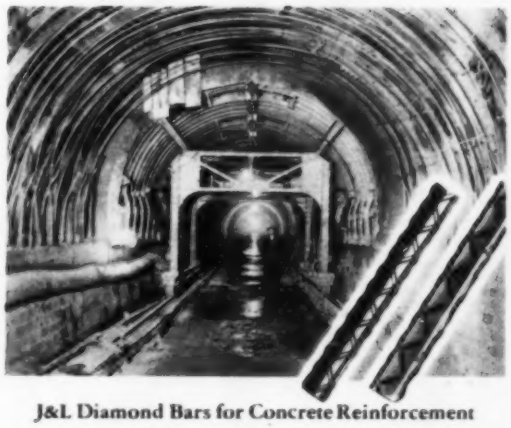
You will profit by buying all the steel construction products you use from Jones & Laughlin. They are available in a wide variety to meet your every need. They are manufactured of selected steel and rigidly inspected and tested to meet not only standard specifications, but also the strict metallurgical specifications set up by the J & L technical staff. Construction time will be shortened and costs reduced when you use J & L construction products, because of their uniform high quality and their close conformity to specifications.

Engineers and contractors everywhere have long profited by specifying and using J & L construction products. You, too, will profit when you look to J & L for all your steel requirements.

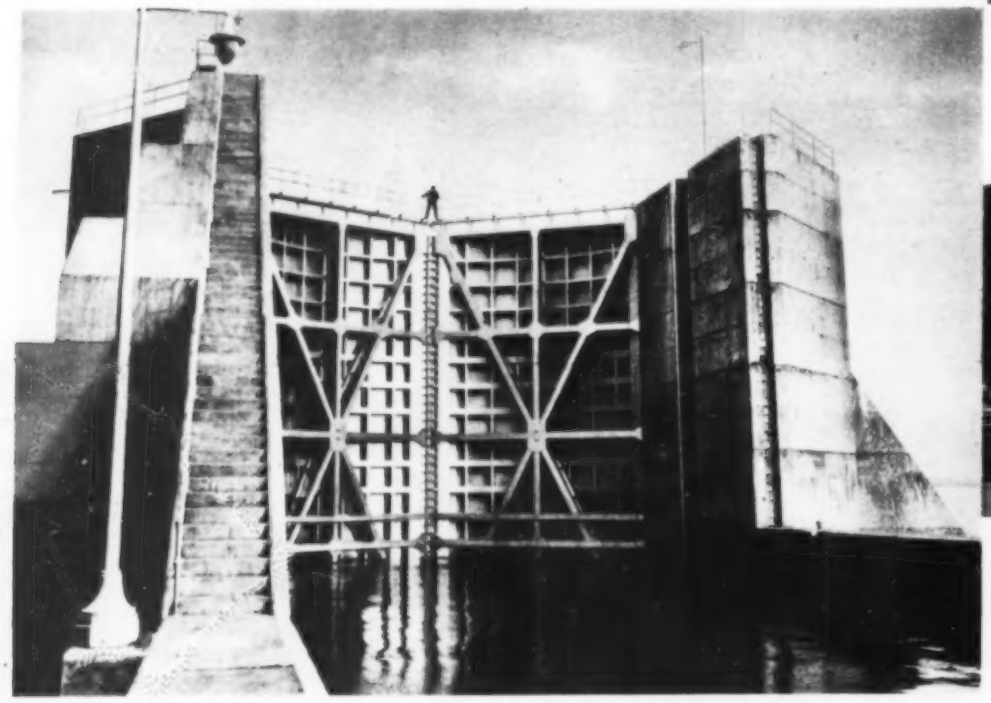


**J&L Diamond Bars for Concrete Reinforcement**

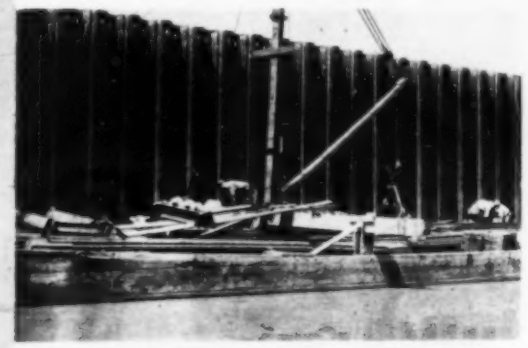
Construction view of 4 Mile Run Trunk Relief Sewer, Pittsburgh, Pa. J & L Steel Reinforcement Bars, used exclusively here, are rolled of new billet steel. They are uniform in cross section, with clean cut accurate ribs, and they have unusual bending qualities.

**J & L Fabricated Structural Work Assures Economical Erection**

All fabricated structural steel used in the construction of the Chevrolet Assembly Plant at Baltimore—the largest of its kind in the country—was furnished by Jones & Laughlin. "Fabricated by J & L" means uniform high quality and economical erection.



Lock and Lower Lock Gates at Dam No.3 T. V. A. Project on the Tennessee River. These gates were manufactured by Tresdwell Construction Company of Jones & Laughlin hot rolled steel plates. These gates are larger than the ones in the Panama Canal locks.



**J & L Steel Piling Gives Economy and Long Life**

J & L Steel Piling bulkheads, such as this one recently constructed at Memphis, Tenn., offer an economical solution to shore protection problems. J & L Steel Piling offers important advantages in all types of steel piling work. Its straightness and proper interlock clearance assure trouble-free performance.

**J & L Nails and Spikes For Every Construction Requirement**

J & L nails and spikes are made of carefully selected wire. They are accurate as to length and gauge, with clean surface, uniform heads and well-cut points.

**LOOK TO J&L FOR ALL YOUR STEEL REQUIREMENTS**

Piling — Plates
Structural Shapes including Junior Beams and Lightweight Channels
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Assembled Road Bar Mats
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NEW MODEL 700 – 12,000 LBS. GROSS
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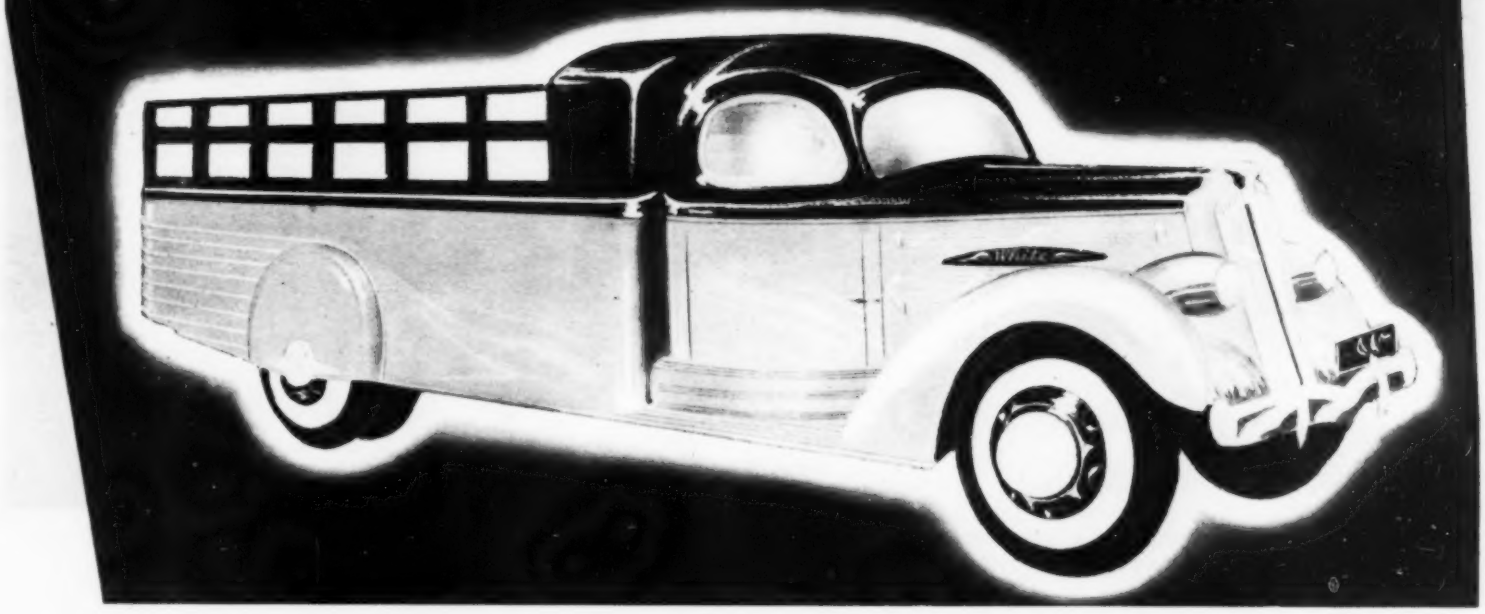
## A NEW WHITE TRUCK AT A NEW LOW PRICE $985

AND UP – AT CLEVELAND PLANT
*for Standard Chassis*



● The biggest year's sales in White history—and White's sensational sales gain last year—nearly four times the industry's average every month—now makes possible White Quality at the lowest price in White history.

This gain came largely from operators who found their low priced "passenger car type" trucks unequal to many of today's hauling requirements.

Now a record low price brings White performance to thousands who want a real truck, quality built as a truck, to do a truck's work.

Every ounce a White—with White's modern performance, unequalled economy, exclusive safety features and "rolling billboard" advertising value—this new White actually costs you only slightly more than the "cheapest" trucks when you add up all the extras.

See it at the White Branch or dealer in your city or telephone for a demonstration.

**THE WHITE MOTOR COMPANY • Cleveland**

THOUSANDS HAVE SAID, *"Some day I hope to own a White"*
NOW THEY CAN
**White TRUCKS**

**A FEW FEATURES OF THE NEW WHITE**

Heavy 7-bearing counterweighted crankshaft with vibration dampener • Improved 4-point rubber engine mounting • Rifle drilled connecting rods • Directionally water cooled exhaust valves • Vacuum controlled distributor providing proper spark advance for every load and speed condition • Down draft carburetor with "hot spot" for perfect vaporization of fuel • White patented combustion chamber • $7\frac{15}{16}$" frame with 3" flange • White designed rear axle with straddle mounted pinion • Chrome nickel alloy gears • 5 optional truck wheelbases • 2 tractor wheelbases • Oversize 4-wheel hydraulic brakes • Automatic ventilated cab, thickly insulated and fume proof.

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When time is a deciding factor . . . when every working hour must count . . . contractors turn naturally to Insley. The Insley Type "K" Shovel is:

● **FAST . . .** 3/4 m.p.h. in low gear and 2 3/4 m.p.h. in high gear, forward or reverse.

● **ACCURATE . . .** each crawler has an independent jaw clutch and friction brake. Thus, the operator has complete control of crawlers under all conditions.

● **ECONOMICAL . . .** powered by a 45 h.p. 6-cylinder motor. Electric Starter Standard Equipment.

Plus these exclusive features: Insley patented chain-drive Crowd . . . gives large yardage and close cutting to the lines. Interchangeable Attachments: Shovel, Dragline, Trench Hoe, Clamshell.

The Insley Type "K" 3/8 cubic yard Excavator is just the shovel for the contractor who wants to make Time and Profit.

*Ask for catalog CM-1. It gives complete details about Insley Type "K" Shovel.*

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# INSLEY

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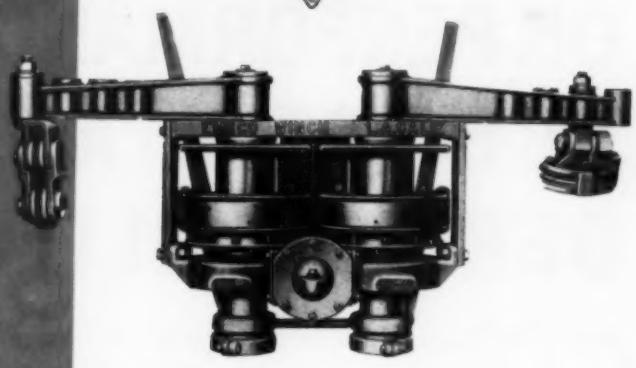
Cable and Hydraulic TRACTOR EQUIPMENT



*A Complete Line of*

# CABLE AND HYDRAULIC CONTROLLED TRACTOR EQUIPMENT

**Emsco hydraulic controlled tractor equipment is the result of a long period of intensive engineering and experimental work. Many of the perfected units are now in the field giving satisfactory and economical service. Other units now undergoing exhaustive tests will be released in the near future.**

**Emsco cable-controlled Trailbuilders and Bulldozers are built for all popular size track-laying tractors and are powered by the highly efficient Emsco winches, supplied in either single or double-drum sizes. Unique patented features assure low up-keep cost of equipment; minimum possible cable wear; and smooth, fast operation of blade at any instant. They are backed by the name and resources of one of the largest manufacturing plants on the Pacific Coast. Detailed information supplied on request.**

TOP: Emsco Power Control Unit, built in single and double-drum types. CENTER: Cletrac Tractor equipped with Emsco Bulldozer. BELOW: Emsco Trailbuilder mounted on Allis-Chalmers Tractor.

BULLDOZERS
TRAILBUILDERS
RIPPERS
SCRAPERS
POWER CONTROL UNITS

# EMSCO

## EMSCO DERRICK & EQUIPMENT COMPANY

TRACTOR EQUIPMENT DIVISION

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## ON PERFORMANCE ECONOMY AND DEPENDABILITY!

1936 has been a MICHIGAN year. Scores of new owners have learned the real meaning of high-speed low-cost truck shovel operation . . . For many state and county officials, too, road maintenance has ceased to be a costly problem . . . Now, with the coming of bad weather the MICHIGAN assumes added significance as an invaluable aid for emergency highway work . . . Before you buy a truck shovel, ask the men who manned MICHIGANS last year!

**MICHIGAN POWER SHOVEL CO.**

BENTON HARBOR, MICHIGAN

Write for Bulletin "C M"

# RELIANCE SAND & GRAVEL SPREADER

*Spreads wet or dry*

*No Rehandling • No loss of material*

**ANY WIDTH FROM 8 TO 60 FT.**

*Will handle up to 60 tons an hour*

**• A SINGLE MACHINE HAS SAVED ITS COST NEARLY 10 TIMES IN 1 YEAR . . .**

**OTHER RELIANCE PRODUCTS**

Rock Crushers
Bucket Elevators
Revolving Screens
Street Sweepers
Storage Bins
Heating Kettles
Wash Boxes
Feeders
Belt Conveyors
Power Units

*spreads ahead of spreader and truck*

**SPREADS 5 TO 15 MILES PER HOUR**

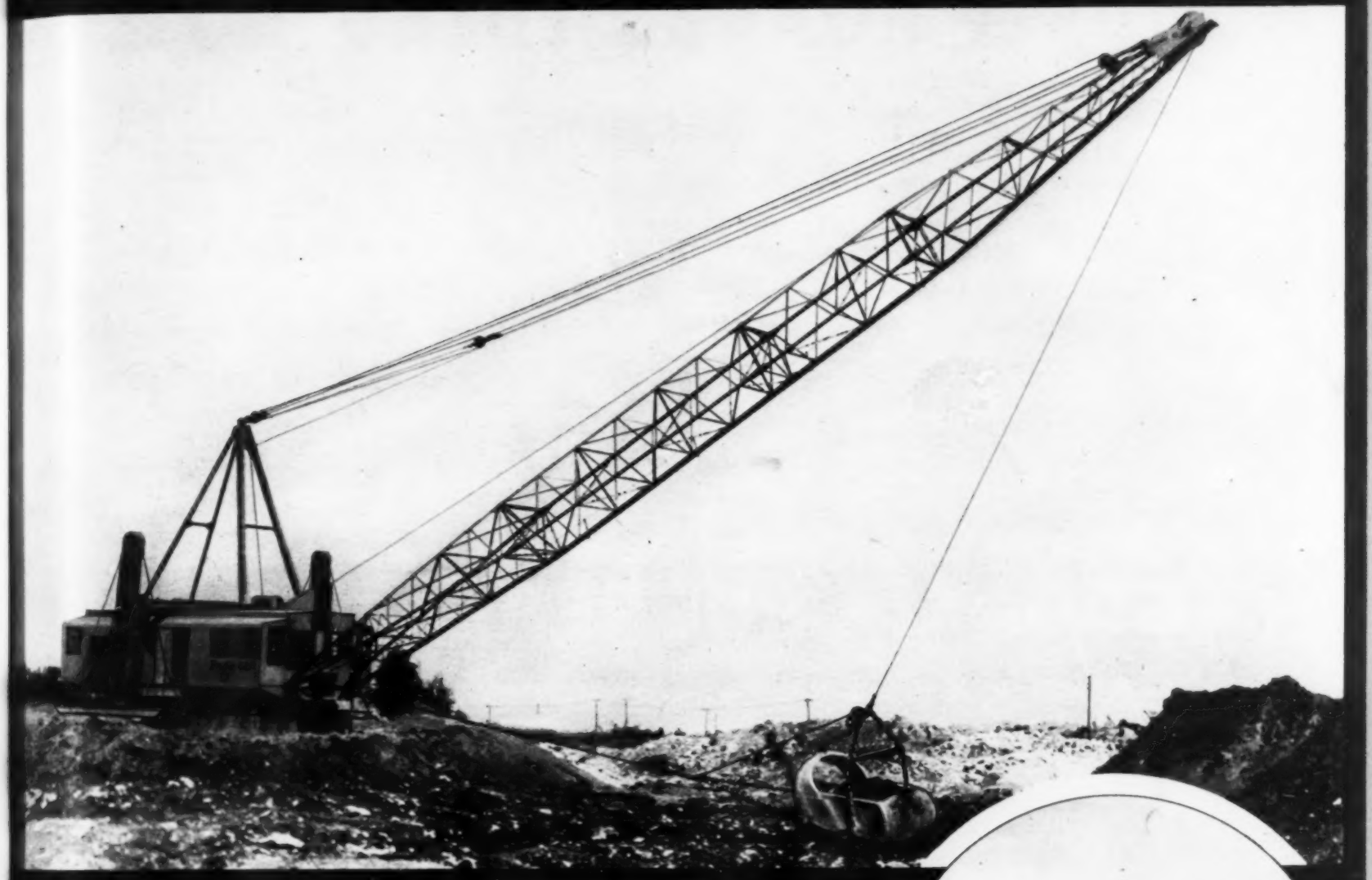
*Equally valuable for both Winter and Summer use — Summer* — Covering oil; Building Sand and Gravel Highways; Resurfacing bituminous Roads. *Winter* — Sanding icy hills and turns.

*send for catalog*

**UNIVERSAL ROAD MACHINERY CO.**

KINGSTON, N. Y.

# Page High Yardage WALKING DRAGLINE



## Moderately Priced—Three to Five Yard Machines Immediately Available

**Diesel powered—by a heavy duty horizontal engine designed particularly for dragline use.**

**High—load—hoist—and swing speeds.**

**Large circular base. Machine can work on the softest ground without mats or danger of miring down.**

**Fairlead, drums, and sheaves designed to reduce cable wear.**

**Simple positive crank action walking mechanism, moves machine on the softest ground, walks immediately in any direction three steps per minute. Reduces machine's original cost.**

**Before buying any dragline, learn what the Page Walker can do on your job! For information write—**

**PAGE ENGINEERING COMPANY**
CLEARING POST OFFICE CHICAGO, ILLINOIS

Please send information on a Page "600" Walker. Size _____

*Name* _____

*Address* _____

*City* _____ *State* _____ "S"

# Page Engineering Co.

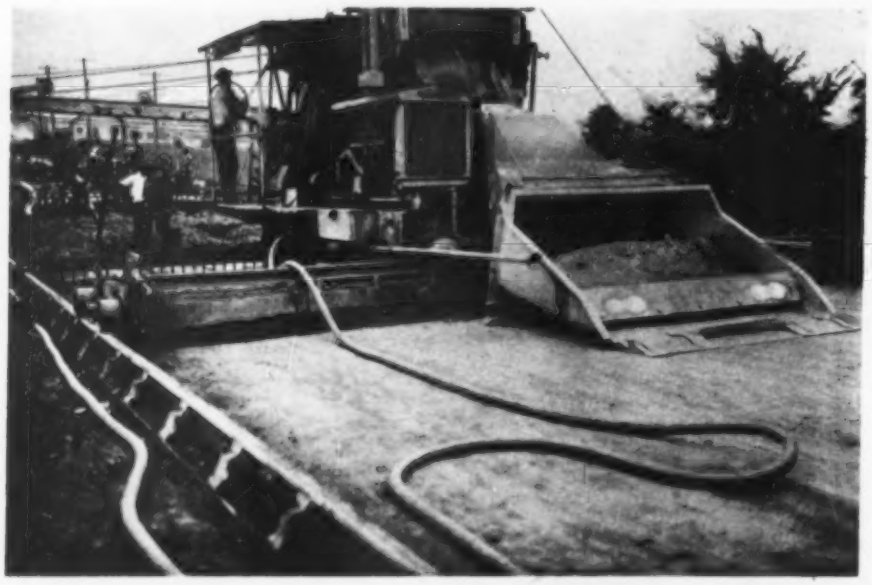
*Clearing Post Office " " Chicago, Ill.*

**PAGE AUTOMATIC DRAGLINE BUCKETS**
**PAGE WALKING DRAGLINE MACHINES**
**PAGE DIESEL ENGINES**

1

Our Best Wishes To The ARBA Convention And Our Sincerest Gratitude For Making

# GOODALL ROADBUILDER'S HOSE



The NATIONAL CHOICE
of ROAD CONTRACTORS

❖

*Every item built to do the job—*
BETTER

❖

**GOODALL RUBBER COMPANY**

New York · Pittsburgh · Cleveland
Philadelphia · Chicago · Houston

**GOODALL MECHANICAL CORP.**

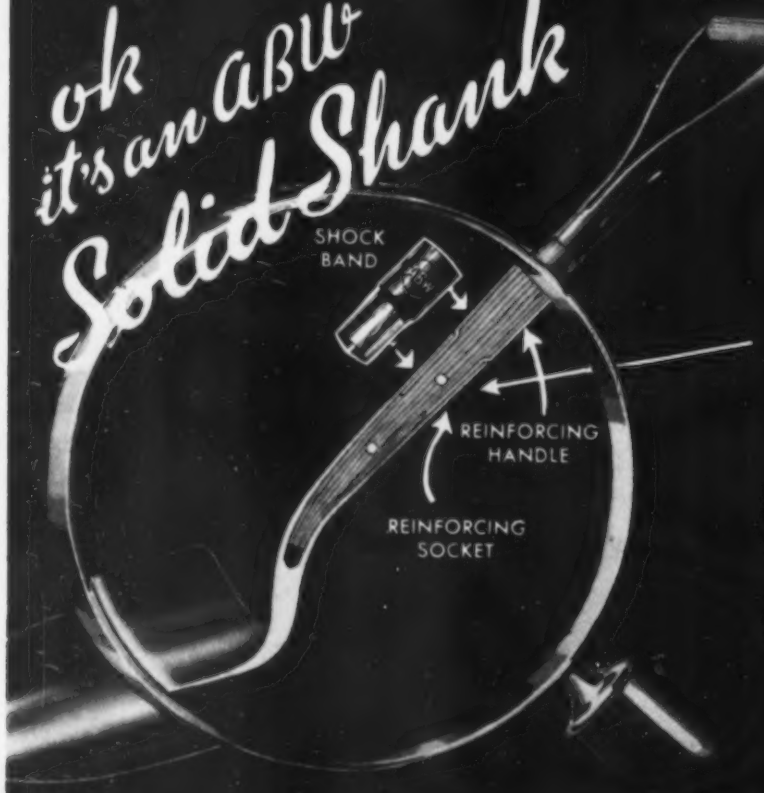
San Francisco · Los Angeles · Seattle

**Mills: Trenton, N. J.**

## GOODALL RUBBER GOODS

The originators of the "Standard of Quality" Line (Reg. U. S. Pat. Off.) of contractor's rubber goods.

*ok it's an ABW Solid Shank*




## Built *to last!*

Here's the reason there is more handle strength to an ABW Solid Shank shovel than the ordinary solid shank shovel. It is the famous ABW Shock Band giving double thickness of steel at the point of greatest strain in the handle. A patented feature only on ABW Solid Shanks.

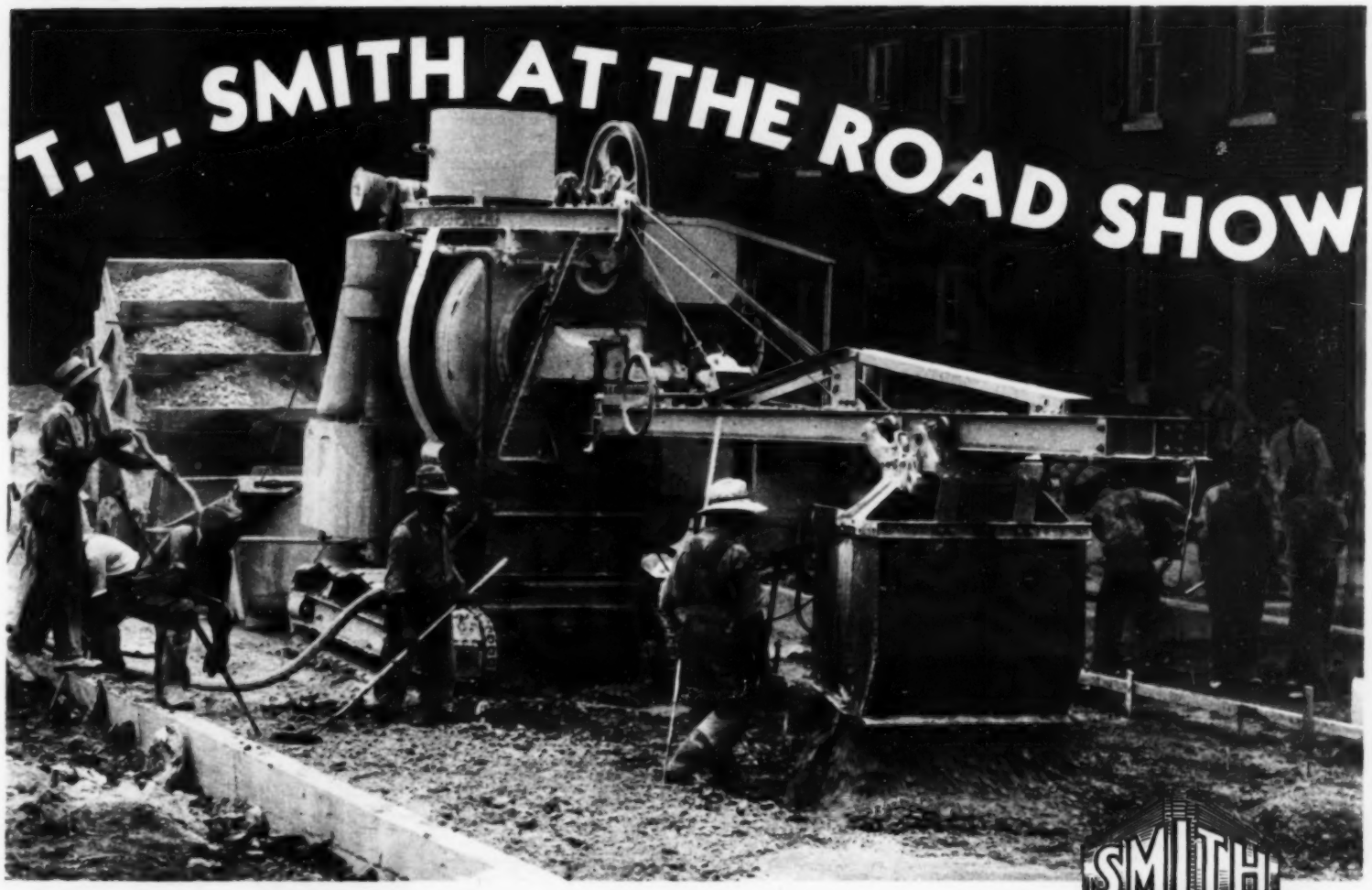
ASK YOUR JOBBER

SINCE 1774

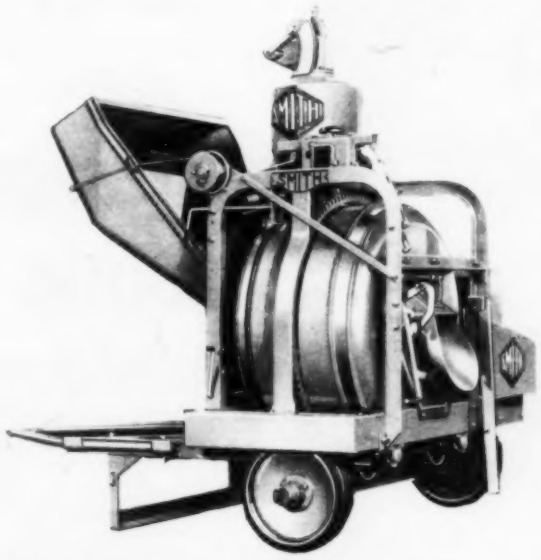
AMES BALDWIN WYOMING CO.
PARKERSBURG W. VA. NORTH EASTON, MASS.

A BW

O. AMES
RED EDGE
PONY
BALDWIN
KNOX-ALL
BRONCO
MONONGAH
HUSKY
PEERLESS
3-STAR
PINNACLE
2-STAR




**SMITH 27-E PAVER** — the modern paver, built to meet today's requirements, and backed by Smith's 37 years leadership in the industry. Contains every device for high speed operation, dependability and low maintenance cost.




**TWO WHEEL TRAIL-SMITH** — the ideal mixer for bridge, culvert and similar jobs. Tows behind car or truck at fast driving speed. Turns in its own length. Fits into tight places. Move it fast — move it often.

**VISIT** the T. L. Smith exhibit at the Road Show . . . New Orleans, January 11 to 16, 1937 . . . Booths No. A-60 and No. A-61. Our engineers and sales representatives will be on deck to shake hands with our contractor friends, and to tell them about T. L. SMITH'S NEW MODERN MIXERS for road paving, bridge, culvert, curb and gutter, sidewalk and alley work.

*If you are unable to attend the Road Show, write for literature.*

THE T. L. SMITH COMPANY

2851 N. 32nd STREET MILWAUKEE, WISCONSIN

# SMITH MIXERS

THE BOULDER DAM MIXERS

## TWO WRENCHES IN ONE

**Each head turns two different sized nuts**

**THE**

# "FAVORITE" Reversible Ratchet WRENCH

## *Is Just The Tool For Contractors*

on the nut-turning portion of the contract that must be speeded up

CADMIUM FINISH

**BUILT OF A STRONG, TOUGH METAL**

Works on a quick straight-ahead ratchet movement, and the socket form of head is not removed from the nut until operation is completed.

Can be used in narrower places than an ordinary wrench.

**A TIME-SAVER**

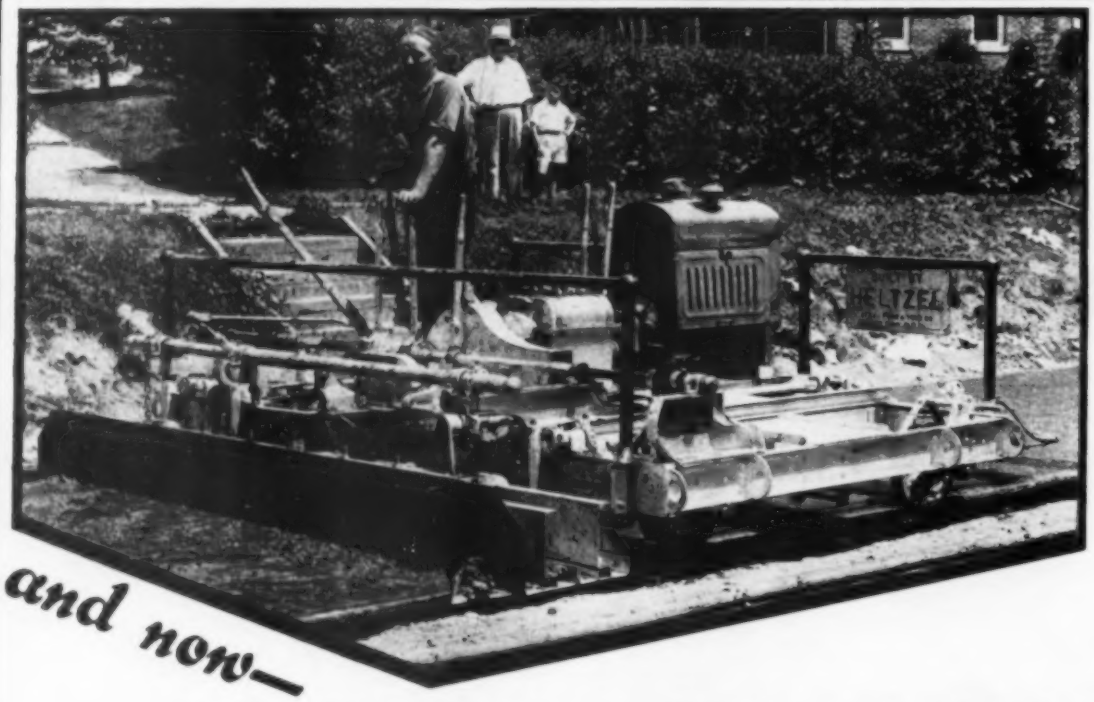
The design of the "Favorite" wrench is simplicity itself, having no complicated parts necessitating expensive machine work.

It is an efficient time-saving tool at a proper price.

Write for full particulars

**GREENE, TWEED & CO.,**
**109 Duane St. New York**
**Sole Manufacturers**






*and now—*

# SEE US at the ROAD SHOW BOOTHS A-76-77

We wish you a successful New Year. Using "FLEX-PLANE" Finishing Machines and Contraction Joint Installing Machines will help a lot.

Our finishing machine screed is 20' wide and it screeds while the machine is reversing. It builds smoother roads than any other machine. Our joint machines will install any kind of contraction joint. You may also be interested in our curb building machines, mesh strikeoff machines equipped with 8 H. P. engines, or our combination and independent dowel rod and expansion joint installers.

## FLEXIBLE ROAD JOINT MACHINE COMPANY

**WARREN, OHIO**

# speak louder than words . . . . . .

With relief labor restrictions the average contractor feels he cannot use a single drum paver to capacity much less a dual drum — a nationally known road contractor paved 11 miles using both a RANSOME Single & Dual Drum Paver. The Dual Drum Paver delivered a 50% increased production over the Single Drum. *Ask for his name.*

Another contractor completed a 12-mile job 42 days ahead of schedule with one RANSOME Dual Drum Paver. Three 27-E Pavers were specified by State to complete job before cold weather. *Will gladly give you his name upon request.*

Write for full details and prices on this and other pavers.

***Meet us at the New Orleans Road Show***
***Booths B 59 - 60 and 61.***

## AND THESE ARE SOME REASONS WHY!

1. Two standard 27-E batches are mixing at the same time.
2. A new pace in production is established throughout entire job.
3. Longer crawlers give less bearing pressure per square inch on the subgrade than ordinary pavers.
4. Waiting time of trucks at paver reduced — because paver can take it.
5. A water tank of positive accuracy — uneffected by grades or starting and stopping of pavers when tank is discharging. An absolutely non-by-passing poppet valve is used.
6. A longer boom is possible because additional weight of paver will accommodate same with safety.

**RANSOME CONCRETE MACHINERY CO.**
**Dunellen, New Jersey**
***Cable address: "Racomaco" Dunellen***

**Ransome CONCRETE PAVERS & MIXERS**

# A *New* COFFING HOIST *for* ROAD WORK

## The picture tells the story . . . . Simplifies Pulling Problems

● Here's *another* remarkable COFFING Specialty for pulling forms, stakes and for those other troublesome jobs which only the road builder knows. The hoist, being detachable, can be used in any number of places where a portable hoisting or pulling tool is required.

● The picture tells the story of its simplicity — its rugged strength — and suggests only one of the many ways you can use it, to save time and labor. Like all COFFING HOISTS, it's precision-built, tested far in excess of rated capacity — dependable!

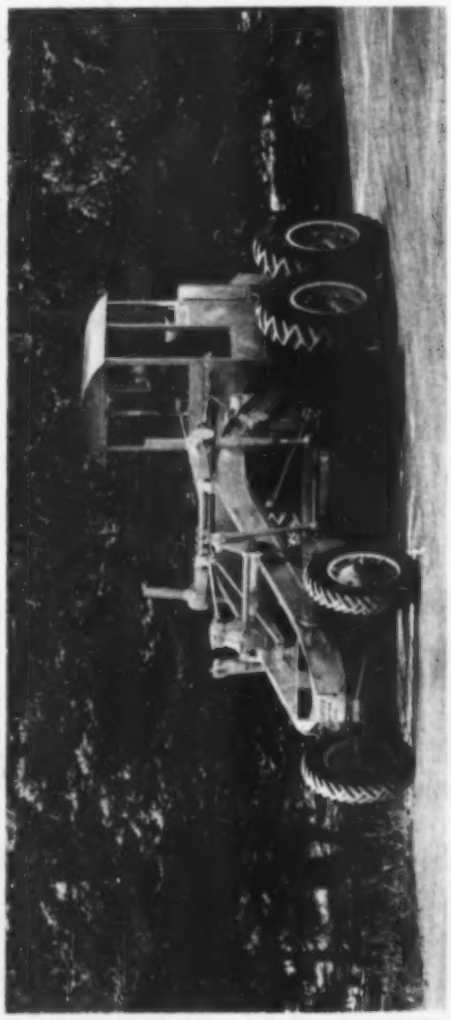
**Many a difficult problem has been solved**

with a COFFING HOIST. Write today for a complete catalogue of these Universal Tools — to simplify your work — speed the job — make more profits.

COFFING HOIST CO.

**COFFING HOIST COMPANY**

**DANVILLE ILLINOIS**



**THE "33" A NEW MODEL,** not just another change, but one that has been designed with forethought and constructed to meet the needs of the highway builders. Streamlined, power controlled, massive circle, heavy duty scarifier, tandem driven, powered by either gasoline or Diesel engine, and backed by the reputation of WARCO.

**W. A. RIDDELL CORPORATION**

Successors to W. A. Riddell Co., Hadfield-Penfield Steel Co.

**BUCYRUS, OHIO**

**Interested Distributors write Dept. C**

*Know the strain*

Get a Martin-Decker Shunt Type Cable Tension Indicator and lower operating costs through definite knowledge of Cable Tensions. It simply clamps onto the cable and measures cable strain with remarkable accuracy.

MADE IN THREE SIZES:

● *The Standard* — for wires or cables from ¼" to ¾", capacity 15,000 lbs.

● *Heavy Duty* — for wires or cables from ¾" to 2¼", capacity 250,000 lbs.

● *The Miniature*—for lines and cables up to 3/16", capacity 200 lbs.

All sizes are adjustable for temperature. Write for Dope on the Martin-Decker Traveling Line Indicator.

**MARTIN-DECKER CORPORATION**

LONG BEACH CALIFORNIA

San Joaquin Valley: A. F. McQUISTON, Bakersfield, California

Mid-Continent Distributor: REED ROLLER BIT COMPANY, Houston, Texas

# 1937

**ROLLERS**

**MOTOR GRADERS**

**PULL-TYPE GRADERS**

**SANDERS DRAGS ROOTERS**

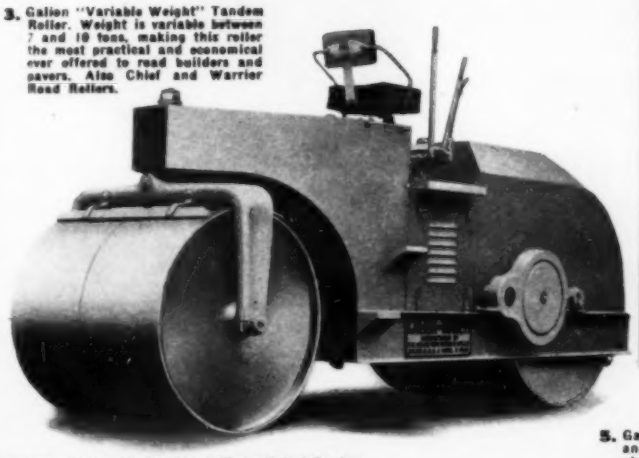
**SCRAPERS SPREADERS BLADES**

# Galion

**1.** Galion builds the smoothest cutting, the easiest operating, and the most efficient Motor Graders to be had anywhere at any price. Furnished in Light weight, Standard (illustrated) or Heavy Duty types with a choice of five outstanding Industrial Power Units; single or double drive; and Hydraulic Control.

**2.** Galion has everything you need in a Leaning Wheel Grader. From any point of comparison . . . design, construction, operation or performance . . . Galion Leaning Wheel Graders have been the outstanding choice of U. S. Government and many state, county and township highway departments for years past. Furnished with Hydraulic or Manual control. A Galion No. 110 with Manual Control is illustrated.

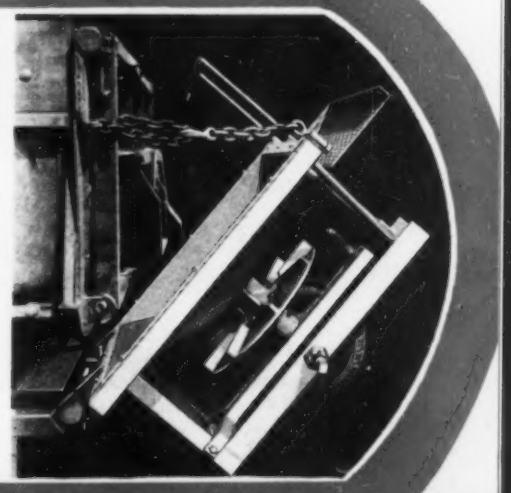
**3.** Galion "Variable Weight" Tandem Roller. Weight is variable between 7 and 10 tons, making this roller the most practical and economical ever offered to road builders and pavers. Also Chief and Warrior Road Rollers.



**4.** Below — Galion Master Diesel Motor Patrol Grader. Built to meet the toughest kind of work . . . powered by a Model TD 40 International Diesel Engine. This big Grader is making records for economy in fuel economy. Hydraulic Control makes it easy to operate. Powered by Case LI Industrial Tractor if desired; single or double drive.

**5.** Galion Portable Roller. Easily and quickly transported from place to place. Flexible steering axle makes close-to-curb rolling easy. An inexpensive roller for rolling patch material . . . for compacting loose material, rolling drives, lawns, etc.

**6.** Galion Highway Sander. Shown at the right attached to truck for towing. Raising the dump body brings the Sander into operating position. Spreads sand, stone dust, cinders, chips and Calcium Chloride at a high rate of speed. You can reduce highway fatalities with this Galion Sander.



● Galion is an organization peculiarly fitted to determine the economies possible in highway construction and maintenance. Manufacturers of a wide line of equipment, Galion offers you the convenience and economy of ONE negotiation . . . ONE organization . . . ONE responsibility.

Galion engineers know Graders . . . they know Road Rollers . . . they know Road Machinery . . . in fact, they have been designing and building Road Machinery for many years. Now that highway construction and maintenance has emerged from the 'emergency' field of work . . . has resumed its normal course, closer attention is being given to the selection of the right equipment for the particular job. This is where Galion can help . . . with the wherewithall to counsel wisely.

Whether it is a massive roller or a small road rooter . . . we invite you to avail yourself of our unexcelled facilities. Our Engineers will gladly discuss with you better ways of building and maintaining those roads and highways.

**THE GALION IRON WORKS & MFG. CO.**

**GALION, OHIO**

## A 1937-GALION-1937 YEAR

# WHERE *Efficiency* IS *Emphasized*

CB59

AS indicated in the accompanying illustration, the Lehigh Portland Cement Company's workings at Sandts Eddy, Pa., is an excellent example of efficient large scale production. Here smooth operation with minimum waste energy is a primary consideration.

Naturally Cordeau-Bickford Detonating Fuse is used. Users of Cordeau recognize that true efficiency starts with the blast. Each charge must result in proper fragmentation, easier removal.

Consider Cordeau and its other advantages: more work from explosives through direct detonation of each cartridge which goes with the force of a primer cartridge; and charges fired in split second rotation for relief of burden. Here is perfect teamwork where teamwork counts.

Let us send you, free, a copy of the Cordeau book.

**CORDEAU-BICKFORD DETONATING FUSE**

THE ENSIGN-BICKFORD COMPANY.
SIMSBURY, CONN.

MAKERS OF ENSIGN-BICKFORD SAFETY FUSE SINCE 1836

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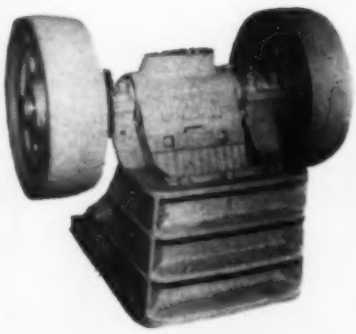
*The sign of . . .*

# *Dependability*

**ROGERS JOPLIN**



All sizes — 6" to 36"

*Our users will tell you about*

The Big Shafts
The Long Bearings
The Heavy Rigid Beds
The Perfect Running Balance
The Simplicity of Replacing Wearing Parts
The Unmatched Capacity

*In fact* ***more Crusher for your Dollar***

**ROGERS IRON WORKS CO.**
JOPLIN • MISSOURI

---

# LET'S TAKE A LOOK AT 1937

* SENSATIONAL IMPROVEMENTS
* NEW ITEMS
* NEW WAYS OF MAKING MONEY

SEE US AND TALK OVER THE CMC LINE FOR 1937.

BOOTHS B-45 & 46
THE ROAD SHOW
NEW ORLEANS
JANUARY 11-15.

**CONSTRUCTION MACHINERY CO.**
WATERLOO, IOWA

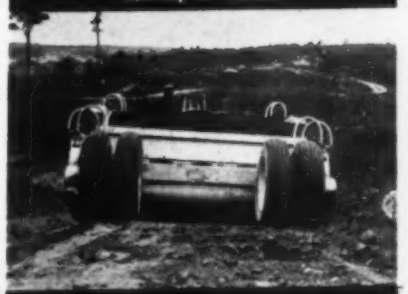
Makers of C.M.C. Mixers—all sizes—pneumatic tired Concrete Carts, Hoists, Pumps, Saw Rigs, Wheelbarrows. Get our prices on the most modern equipment in the industry.

# GAR WOOD

## HYDRAULIC SCRAPERS

Finger tip control of angle of dig, depth of dig and front gate setting, enables the Gar Wood Scraper to load all materials ranging from the lightest sands to tightly compacted clays, adobes, shale or loose rock.

Loading completed. Closing front gate and hoisting for travel.



Travelling in high gear. Note that wheels are inside the cutting width of bowl

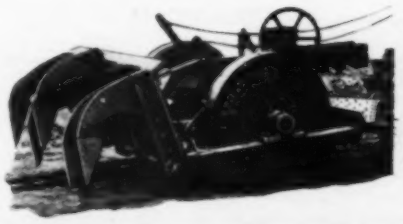
Dumping and spreading loose rock.

# FIRST IN ECONOMICAL USE OF POWER IN ECONOMICAL MOVING OF EARTH

**No other scraper in the world is as precisely controlled as the Gar Wood Hydraulic Scraper. No other scraper has its exclusive "crowding" action, which enables it to get crown loads in any soil. For these two very important reasons, the Gar Wood Scraper excels in the economical moving of earth. Hydraulic equipment permits applying power in any direction required. Peak ability to dig and load, lift and haul, dump and spread — and to shorten the wheelbase for maneuverability — results in amazing economy of time and cost. Your choice of four sizes to fit your kind of job. Write for details.**

*Road Machinery Division,* **GAR WOOD INDUSTRIES, INC.**
**Detroit, Michigan**

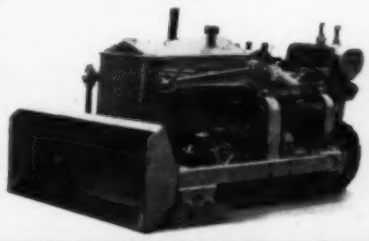
## SEE YOU AT THE ROAD SHOW



Gar Wood self-cleaning "Rip-Rooters" provide a machine for rough service as well as quick and simple operation.

●

A complete line of road-builders and bulldozers available. All models have Gar Wood hydraulic controls.



KOPPERS

Serves
the
Public Works
Field

# PERS

Few people have any conception of the many ways in which Koppers serves the public works field.

Koppers is one of the important sources of road tars, and supplies millions of gallons of Tarmac to cities, townships, counties and states.

It operates great wood-treating and wood-working plants where lumber is cut to size, adzed, bored and treated with creosote or other preservative materials for bridges, culverts, guard rails, posts, poles and for structural purposes.

It designs and builds the type of incinerator furnaces used in the majority of the larger municipalities in America, and it has helped to save thousands of dollars by generating electricity from the steam produced.

It is the only company producing Fast's self-aligning Couplings which are widely used for power shaft connections.

Koppers manufactures gate valves for water works and water distribution systems and equipment for sewage disposal plants. It makes some of the largest bronze castings produced in this country. It built the gates for the Norris, Wheeler and Fort Peck dams, and many smaller ones. It makes tunnel liners and other gray iron castings.

It designs and builds complete gas-producing plants, and gas holders. It has developed an improved type of fire hydrant.

It produces disinfectants, insecticides, weed-killers, deodorizers, paints and scores of other products.

**KOPPERS COMPANY**
**PITTSBURGH · PA.**

**KOPPERS**
**DIVISIONS**

American Hammered
Piston Ring Division

Bartlett Hayward Division

Engineering and
Construction Division

Gas and Coke Division

Tar and Chemical Division

Western Gas Division

**KOPPERS**
**SUBSIDIARIES**
**AND AFFILIATES**

Eastern Gas and Fuel
Associates

Hiler Engineering and
Construction Company, Inc.

The Koppers Coal Company

Koppers-Rheolaveur
Company

The Maryland Drydock
Company

The White Tar Company
of New Jersey, Inc.

The Wood Preserving
Corporation

# Another Rogers Trailer Achievement!

**Gooseneck Trailer With**
**Front Dolly Provides Haulage Flexibility**

● The most exacting basis for judging heavy duty trailer performance is AVERAGE SERVICE. There are times, however, when unusual jobs tax the ingenuity of contractors pressed for time. An example is illustrated here. A 75 ton Rogers Gooseneck Trailer with semi-trailer dolly moves a Bucyrus-Erie shovel from one California project to another.

**"EXPERIENCE BUILT IT — PERFORMANCE SOLD IT"**

Over-all length (as semi-trailer) 36'6". Over-all length of complete trailer with semi-trailer dolly, 47'9".

Rear gears of semi-trailer consist of 8 wheels on 4 rocking axles, each wheel equipped with dual 9.75x15 twelve ply tires.

Rear gears of dolly consist of 4 wheels on 2 rocking axles, each wheel equipped with one 13.50x24 sixteen ply tires. Deck of semi-trailer 11'6" wide and 18' long from back of gooseneck to front of rear wheels.

Loading height at rear is 35" — loading height of deck is 29" — without load.

**ROGERS BROTHERS CORPORATION . . . ALBION . . . PA.**

Bridge Builders

Clyde Hoists and Derricks . . . designed to give better performance for the bridge contractor who wants portable, inexpensive at high quality, dependable equipment.

A complete range of sizes to meet the requirements of almost any kind of work; hoists from 4 to 175 horsepower; derricks from one to 50 tons capacities.

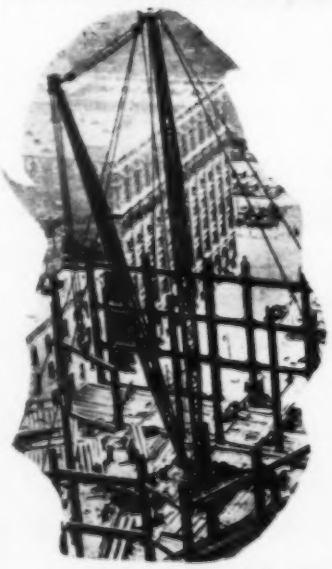
Clyde engineers will gladly make recommendations and furnish specifications.

Below is shown a 3 ton Clyde Utility Derrick, 20 H.P. 2 drum Clyde Gasoline Hoist with swinger. This derrick was specially designed for building county highway bridges.

**CLYDE IRON WORKS, Inc.**
**DULUTH, MINN.**

TRADE MARK
DOBBIE
ESTABLISHED 1862

# All Steel DERRICKS



Steel Erectors Guy Derrick, with Ball Bearing Footblock.

***Guarantee Safety***

When you guarantee safety, you economize — for safety means uninterrupted operation and lowest possible maintenance costs.

And DOBBIE All-Steel Derricks have been designed for safety and consequent economy. They have a safe load capacity of almost twice their rating. You need this assurance of dependable safety and continuous performance.

SAVE POWER BY USING BALL OR ROLLER BEARING FOOTBLOCKS AND SHEAVES. Built in both Guy and Stiff-leg types. Write for information and prices.

**DOBBIE FOUNDRY & MACHINE CO.**
**Niagara Falls, N. Y.**

*Other Dobbie Products*—Steel Derricks, Timber Derrick Fittings, Hand Winches, Motor Driven Winches, Blocks, Sheaves, etc.

"If a man can make a better Mousetrap . . . than his neighbor — though he build his house in the woods — the World will make a Beaten Path to his door."

*RALPH WALDO EMERSON*

MODEL 38 ⅝ cu.yd. BAY CITY — 1 of 10 SIZES

# The PATH that leads to BAY CITY

## *is Broad and Well Beaten!*

—Bay City, Mich., is not *quite* in the woods.

—*Some* credit for the path is due the State Highway Dept.

—Bay City machines have *not* been called "Mousetraps".

But the signposts plainly read — "Successful and Dependable Performance".

BAY CITY owners are enthusiastic users — they do not keep their good judgment secret. They tell others Bay City machines perform better, more efficiently and economically than any other shovel they have ever owned. They are repeat buyers — not stampeded by high-pressure selling, but select what they think most desirable in design and performance.

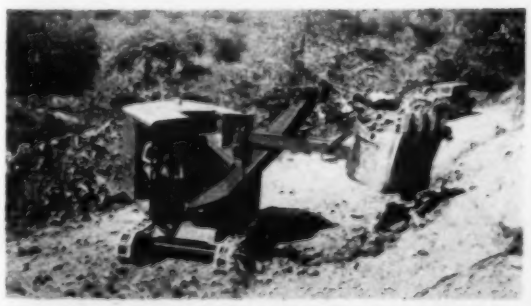
When they *select* — they BUY BAY CITY. —

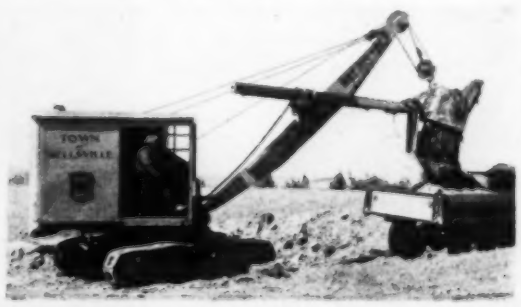
And buy with confidence.

BAY CITY is completing the biggest sales volume in its history. There is a reason . . . Ask us — we'll give you the evidence . . . Ask a Bay City Owner — or better still, join the growing list of Bay City users and experience new heights of equipment satisfaction.

10 Models — ⅜ yd. to 1¼ yd.

Sensibly Designed—Honestly Advertised—Fairly and Moderately Priced.





*Recent Quantity Purchasers:* 8 Model 20's State of N.Y. Dpt. of Pub. Wks.; 8 for New Zealand Pub. Wks. Dept.

## 25 REASONS FOR CHOOSING BAY CITY

1—Convenient economical weight.
2—Helical cut gears—noiseless, long wearing.
3—Unit (nickel-manganese) car body and machinery table, totally heat treated.
4—Frictionless bearings thruout.
5—6-cylinder power.
6—Extra large diameter swing roller-path.
7—Oversized clutches & brakes.
8—Drop forged crawler shoes.
9—Long crawlers—low bearing pressure.
10—Chain crowd with automatic adjustment.
11—Swing lock—in any cab position.
12—Automatic Travel lock.
13—Extra heavy cab. Plenty inside working room.
14—Fast operating speeds.
15—Two travel speeds.
16—All steel construction.
17—Three lever control.
18—E-Z clutch control.
19—High pressure lubrication thruout.
20—Safety worm boom hoist.
21—Separate hoist drums.
22—Internal swing teeth.
23—Unequalled steering at full speed.
24—Convertible—without machinery change.
25—Accessibility for inspection or adjustment.

*Send for details*

**BAY CITY SHOVELS Inc.** (Eastern Offices, Roselle, N. J.) **BAY CITY, MICH.**

# TAKE THE WORRY OUT OF BREAK DOWNS!

## KEEP GOING WITH Snap-on Tools

Good weather . . . full speed ahead . . . nothing to worry about, except . . .

EXCEPT how complete and how modern is your tool equipment?

Take the worry out of breakdowns with Snap-on Wrenches. Pitch into every repair job with confidence that it will be finished at a *definite* time . . . and in the *shortest* time!

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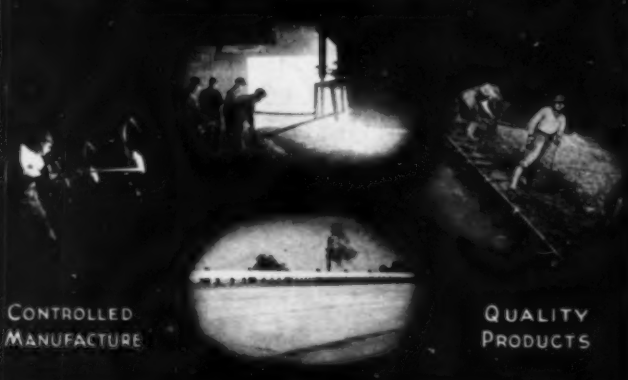


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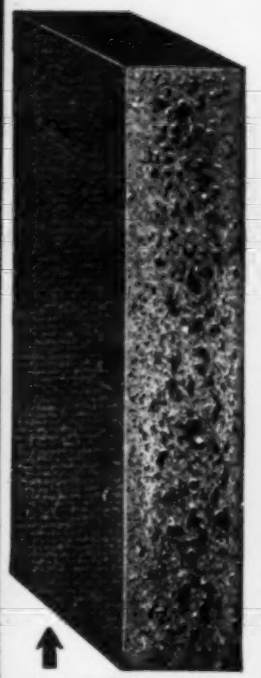

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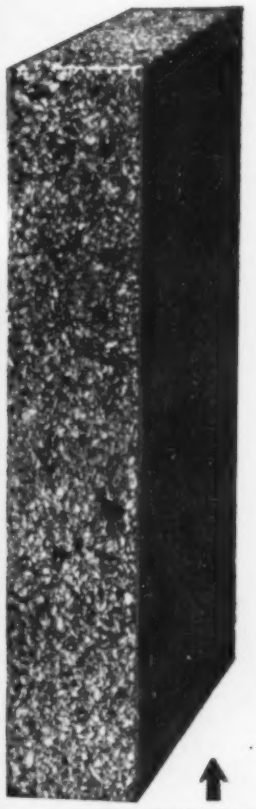
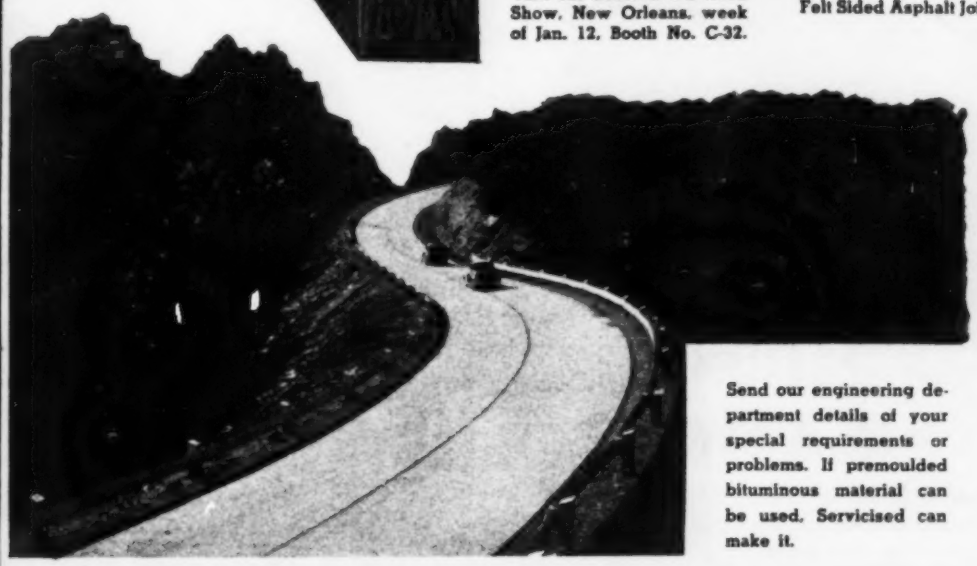


Cork Rubber Joint



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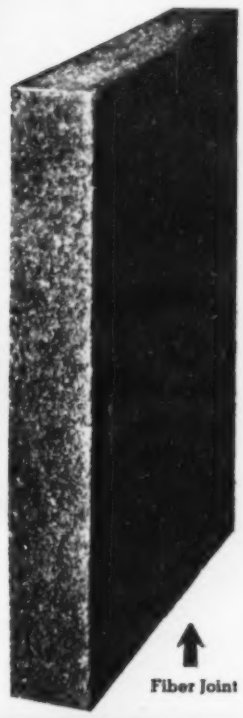

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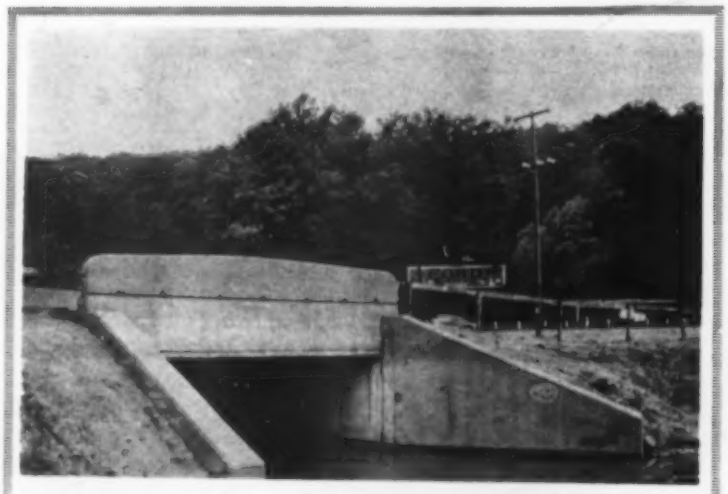

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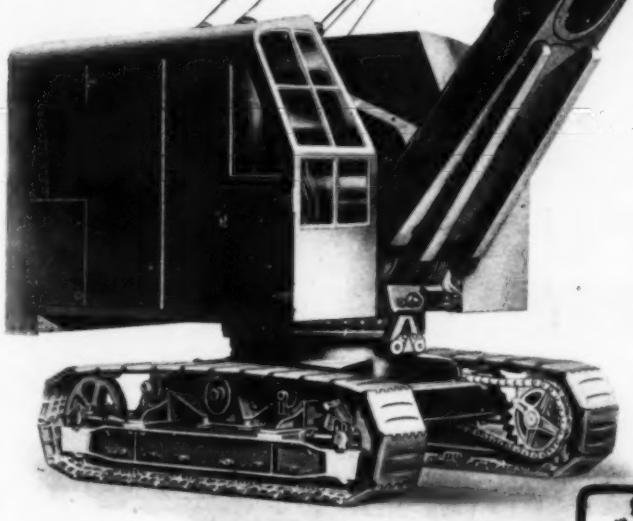

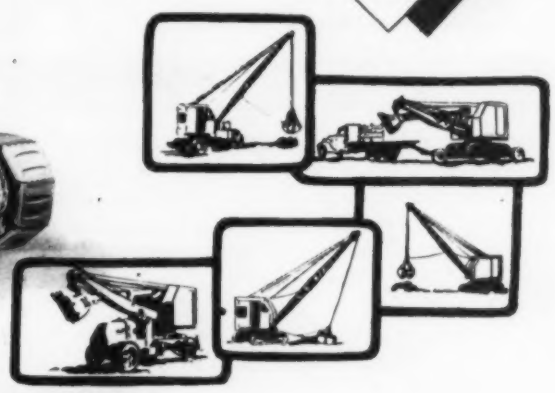

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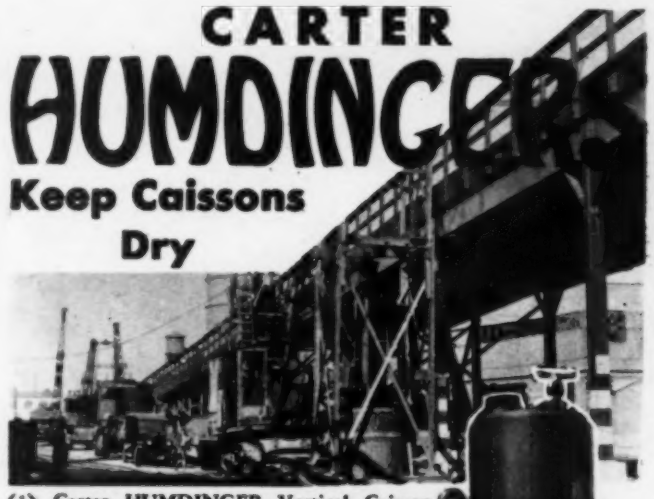

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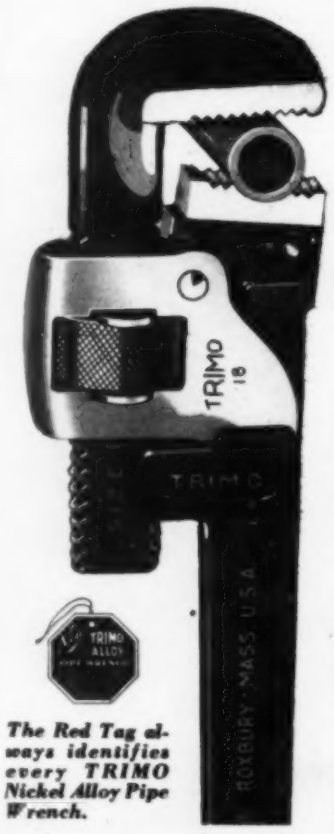





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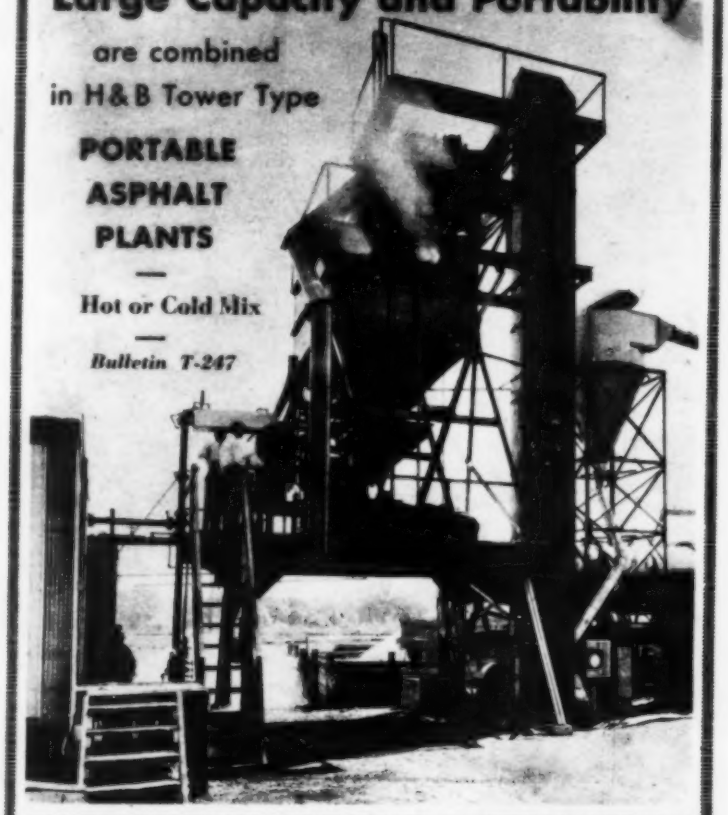

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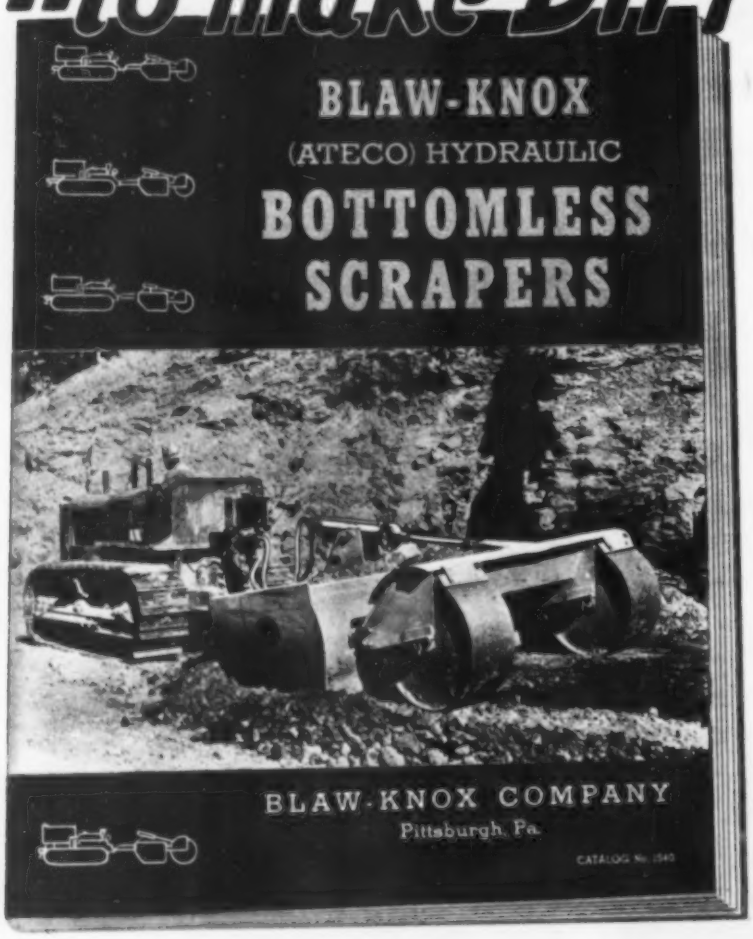


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**It will pay you to investigate this BOTTOMLESS SCRAPER—also the Blaw-Knox (Ateco) Sheepsfoot TAMPING ROLLER.**

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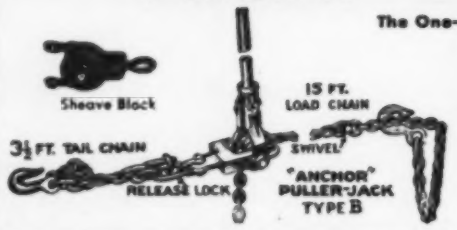


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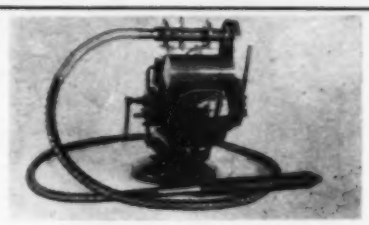

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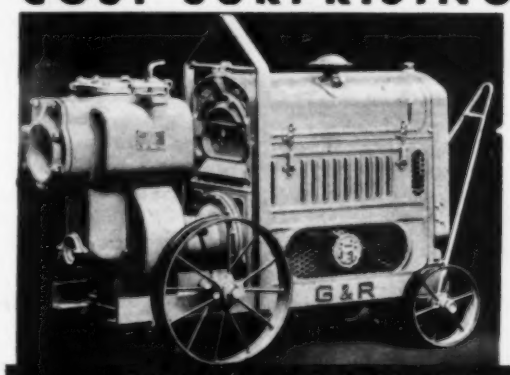


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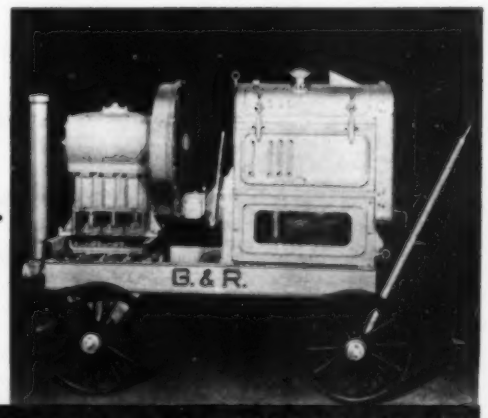


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